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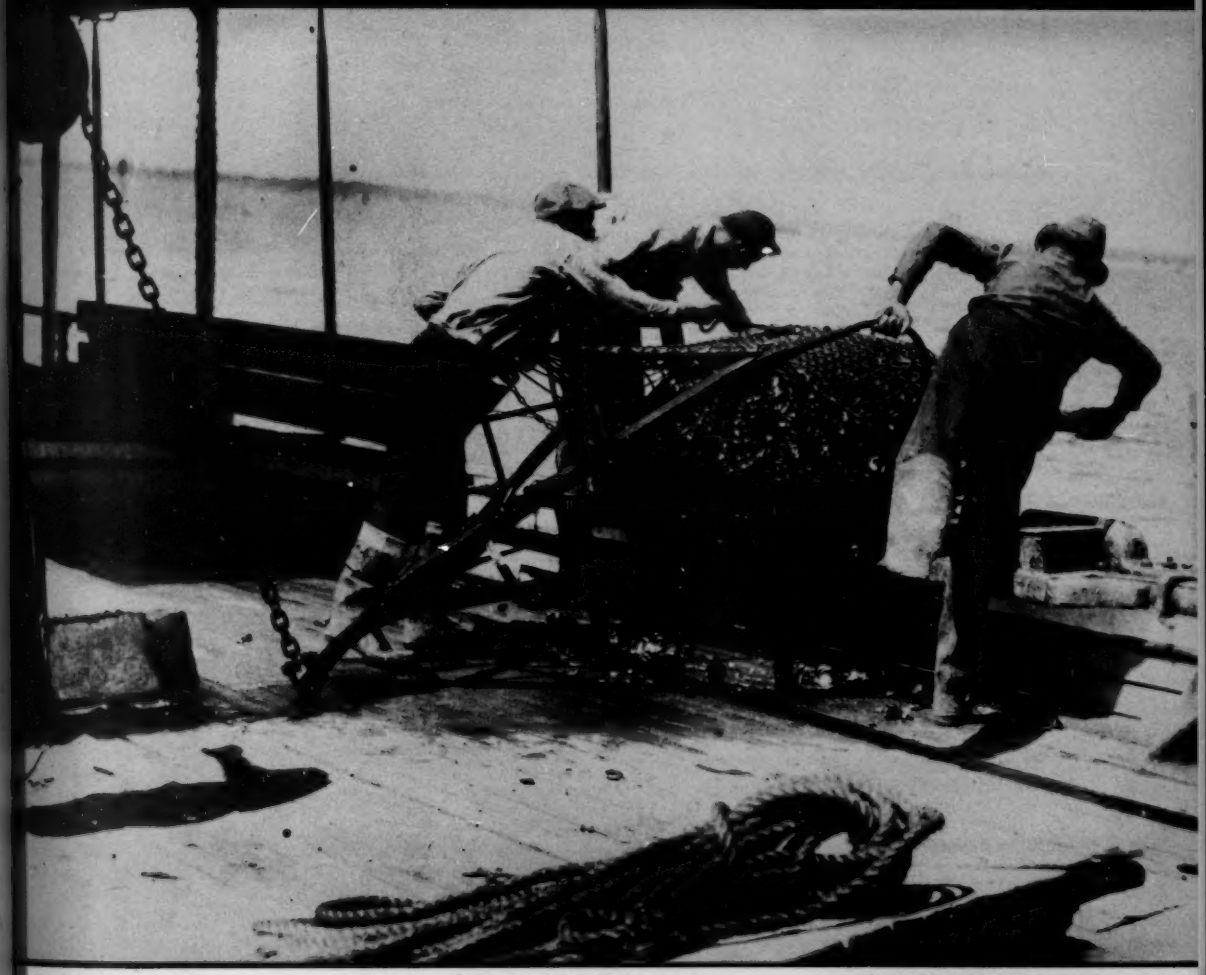
# COMMERCIAL FISHERIES REVIEW



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United States Department of the Interior
Washington, D.C.

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, Secretary

FISH AND WILDLIFE SERVICE
ALBERT M. DAY, Director

# COMMERCIAL FISHERIES REVIEW

A REVIEW OF DEVELOPMENTS AND NEWS OF THE FISHERY INDUSTRIES
PREPARED IN THE DIVISION OF COMMERCIAL FISHERIES

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F. J. Anderson, Assistant Editor

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# COMMERCIAL FISHERIES REVIEW

September 1947 Washington 25, D.C. Vol. 9, No.9


## RELATIONSHIP BETWEEN BODY LENGTH OF GRAYFISH AND VITAMIN A IN LIVER


By F. Bruce Sanford* and Kelshaw Bonham **



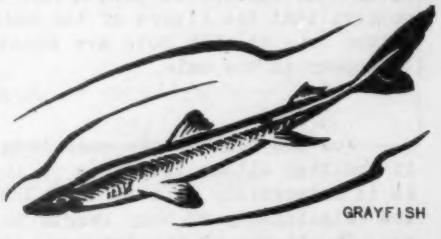
ABSTRACT

The vitamin A potency of the liver oil of the grayfish (Squalus suckleyi) is correlated with sex, sexual maturity, and length of fish. The vitamin A potency of the small fish is relatively low and increases as the fish grows in length. In the case of both the male and female, the most rapid increase occurs as the fish matures sexually. The weight and oil content of the liver also increases and the color of liver darkens as the fish increases in length and matures. As a consequence, the small, immature fish are relatively valueless as compared with the larger fish which have reached maturity.


- - - - -

### INTRODUCTION

In 1942, the Washington State Department of Fisheries and the Seattle Fishery Technological Laboratory began a joint study of the Washington grayfish (Squalus suckleyi) to determine whether measures were needed to protect this important source of vitamin A and, if so, how they might best be applied. A short summary at this time of the more important observations on the characteristics of the grayfish which are correlated with vitamin A content will be of value. In this paper is presented a summary of the relationships observed between the content of oil, vitamin A potency, weight and color of liver, and the sex, length, and state of maturity of the fish.



GRAYFISH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EDITOR'S NOTE: Studies by the Bureau of Marine Fisheries, California Division of Fish and Game, revealed that immature soupfin sharks do not contain enough vitamin-laden oil to warrant their capture.

The nurseries and pupping grounds of the soupfin shark are located in shallow water along the California Coast.

To protect and perpetuate these prime producers of vitamin A, a regulation sponsored by the Bureau of Marine Fisheries and the fishing industry was enacted by the last legislature. The regulation, effective September 19, outlaws the taking of soupfin shark in less than 25 fathoms (150 feet) of water. The regulation applies to sportsmen and fishermen alike.

## SUMMARY OF OBSERVATIONS AND DISCUSSIONS OF THEIR SIGNIFICANCE

### Liver Color

In the study of color, the livers were classified visually into five groups: light, medium-light, medium, medium-dark, and dark. These groups were numbered from 1 to 5, the lightest-colored livers being rated 1 and the darkest-colored livers being rated 5. The classification was done visually as the use of photo-electric or similar devices was impractical under the working conditions.

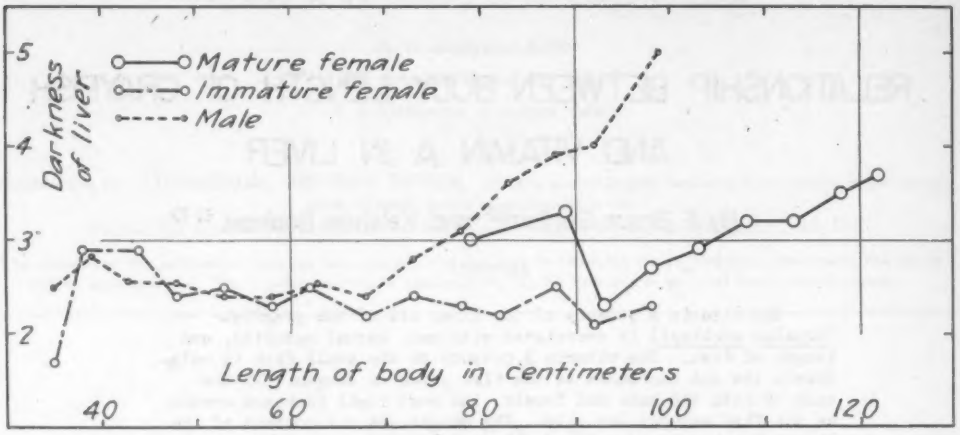


FIGURE 1 - RELATIONSHIP BETWEEN DEPTH OF LIVER COLOR AND BODY LENGTH

There seems to be a positive correlation between liver color and sexual development. Figure 1 shows that among females of the same size, those which were sexually mature[1/] had the darker livers. Males start to mature at a length of 60 to 70 centimeters, and as the male grows larger than this, the average color of the liver darkens rapidly. This same trend occurs among the females. Almost all females longer than 100 cm. are mature; and, in this group, the color of the liver also darkens in proportion to the length of fish. It is interesting to observe that the livers of the males start to differ from the livers of the immature females when both are about the length at which signs of maturity begin to appear in the male.

### Liver Weight

For the fish of the same length, the immature females tend to have heavier livers than either the males or the mature females (Figure 2, see p. 3). Again it is interesting to note that the male and immature female start to differ in the relationship of body length to liver weight at a length of fish of about 60 cm. The livers of the immature specimens are smaller in proportion to the size of the fish than is the case in the larger specimens. The livers constitute 8 percent of the weight of the small fish and about 12 percent of the weight of the large fish. The industry has found that a liver weight of 10 percent of weight of fish is a satisfactory rough average to use in calculations.

1/ A female was judged to be sexually mature if it had eggs or embryos in the uteri. A male was judged mature if sperm was present in the seminal vesicle. Since sexual maturity was not determined for the earlier observations on the males, separate data for mature and immature males are not presented.

## Liver Oil Content

The content of oil in the livers of the smallest grayfish is only 20 to 30 percent of the weight of the liver (Figure 3, see p. 4). As the small fish grow, the oil content of livers increases rapidly. By the time the fish have reached a commercial size (about 76 cm. or 30 in. in length), the oil content of the livers has increased to more than 60 percent. Further growth results in a slow increase in the oil content of the livers to about 75 percent. Thus, in the commercial fishery, oil yields below 60 percent and above 75 percent are seldom encountered. The average is about 68 percent.

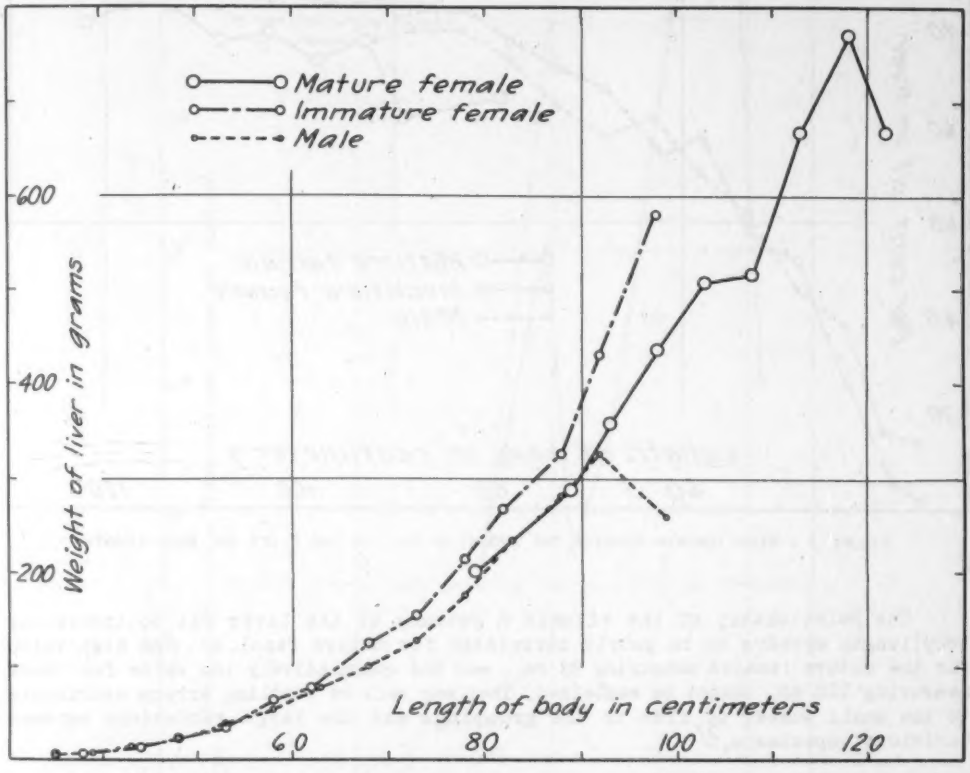


FIGURE 2 - RELATIONSHIP BETWEEN LIVER WEIGHT AND BODY LENGTH

For fish of the same length, the livers of the mature females contain less oil than the livers of the immature females. It will be noted, as is true for liver color and weight, that a difference in the oil content of the livers appears between the males and immature females at a length of fish of between 60 and 70 cm.

## Vitamin A

The vitamin A potency of the liver oil appears to be correlated with sexual maturity. The immature fish of both sexes have liver oil of about equal vitamin

A potency and of a relatively low value (Figure 4, see p. 5). After signs of maturity appear in the male at a length of 60 or 70 cm., there is a large increase in the vitamin A potency of the male liver oil with further increase in the length of the fish. In contrast, the vitamin A potency of the liver oil of the immature female increases, but slowly. By the time a fish length of 90 cm. has been reached, the male liver oil contains about 4½ times as much vitamin A as does that of the immature female.

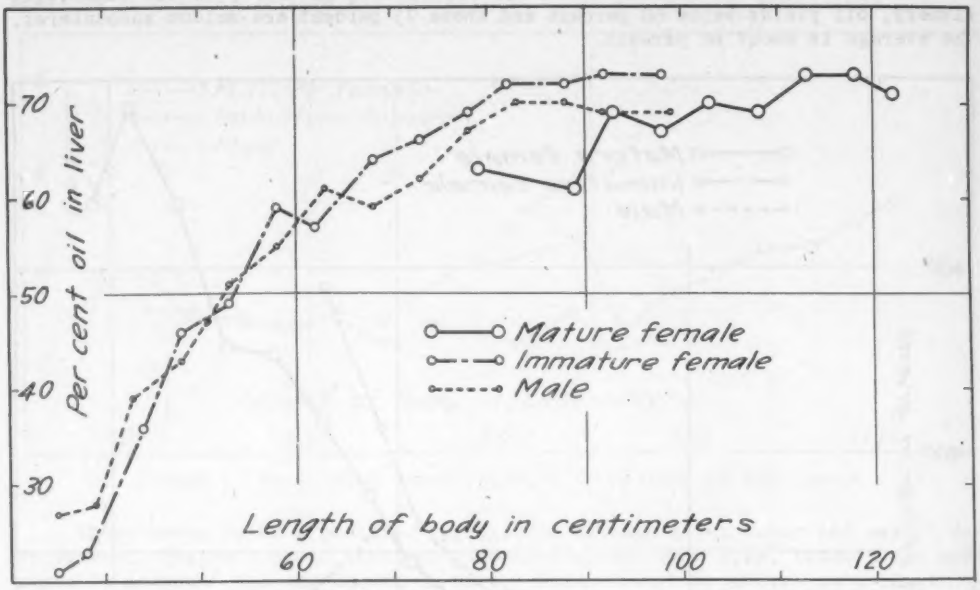


FIGURE 3 - RELATIONSHIP BETWEEN THE AMOUNT OF OIL IN THE LIVER AND BODY LENGTH

The relationship of the vitamin A potency of the liver oil to increasing body length appears to be poorly correlated for mature females. The high value for the mature females measuring 88 cm., and the comparatively low value for those measuring 122 cm. cannot be explained. They may well be sampling errors ascribable to the small number of fish in the groupings and the large variations between individual specimens.2/

There is a marked difference in vitamin A potency of liver oil of the mature and immature female. Even for fish of the same length, the vitamin A potency of the mature female liver oil is considerably greater than that of the immature female. At a length of 100 cm., all or nearly all female grayfish are mature. As the female grows longer than this, the vitamin A potency of the liver oil increases greatly. Thus, the liver oil of both the male and female shows a rapid increase in vitamin A potency as the fish matures.

2/ The total number of specimens examined was 1,097, of which 555 were males, 364 were immature females, and 178 were mature females. With 14 length groups for the males, 14 for the immature females, and 9 for the mature females, each length group contained on the average, 40 specimens in the case of the male, 26 specimens in the case of the immature female, and 20 specimens in the case of the mature female. The length group for the mature females measuring 88 cm. contained only 7 specimens, and the length group for the mature females measuring 122 cm. contained only 3 specimens.

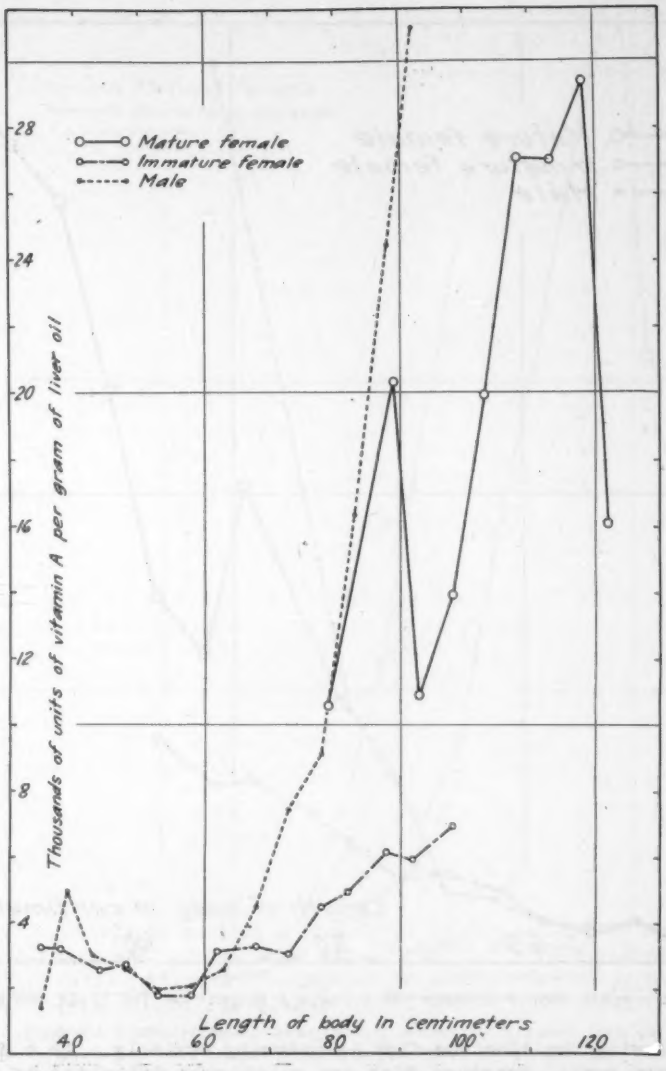


FIGURE 4 - RELATIONSHIP BETWEEN THE VITAMIN A POTENCY OF THE LIVER OIL AND BODY LENGTH

The commercial fisherman will be especially interested in the vitamin A potencies of the liver (Figure 5, see p. 6) since he is paid on this basis. As might be anticipated, the graph showing the relationship between this potency and the length of the fish is similar in appearance to that showing the relationship between the vitamin A potency of the liver oil and the length of the fish.

Of the various relationships studied in the investigation, the most important to the fishing industry is that between the vitamin A potency of the individual liver and the length of fish (Figure 6, see p. 7). The importance of the relationship depends upon the large increase in vitamin A potency of the liver oil which

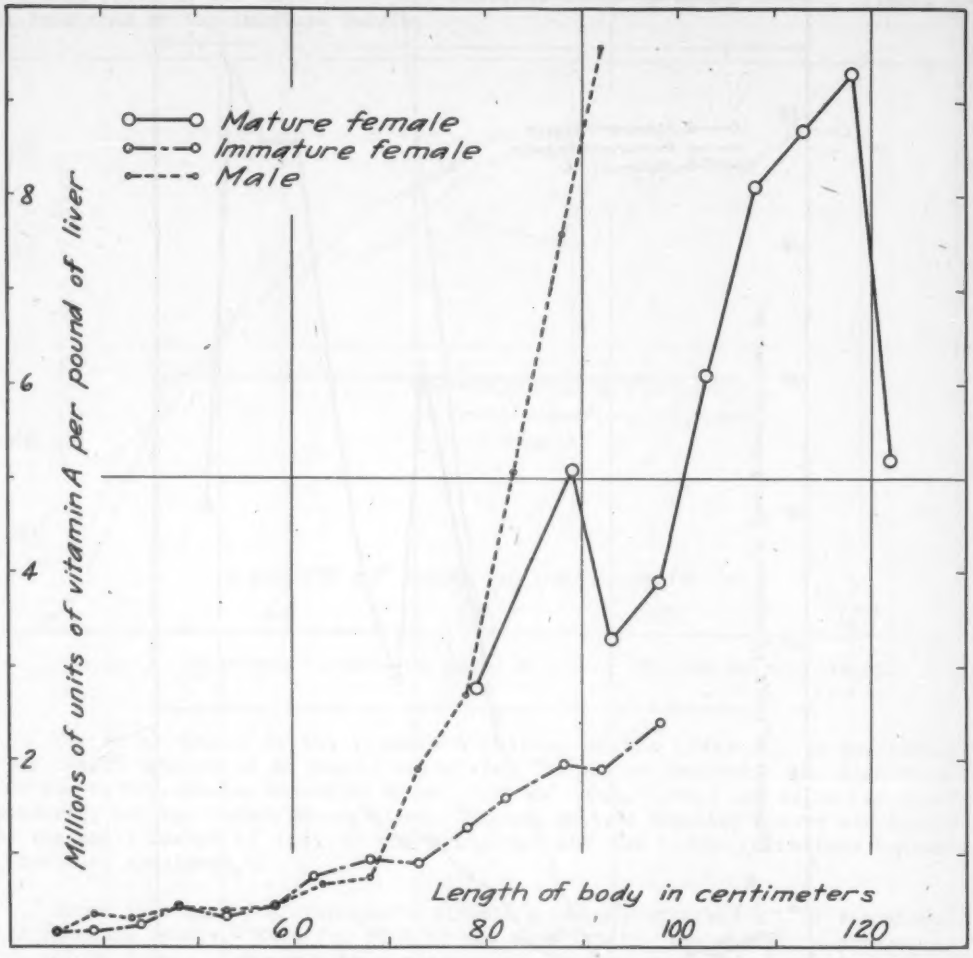


FIGURE 5 - RELATIONSHIP BETWEEN THE VITAMIN A POTENCY OF THE LIVER AND BODY LENGTH

takes place during the time the fish is maturing sexually. As a result of this phenomenon, the small, immature fish are relatively valueless as compared with the larger fish which have reached maturity. The implication is clear, of course, that to take the small fish is a waste not only of the fishermen's time but of a valuable resource. In recognition of this fact, the governmental agencies charged with the conservation of fish on the Pacific Coast have recommended that no male

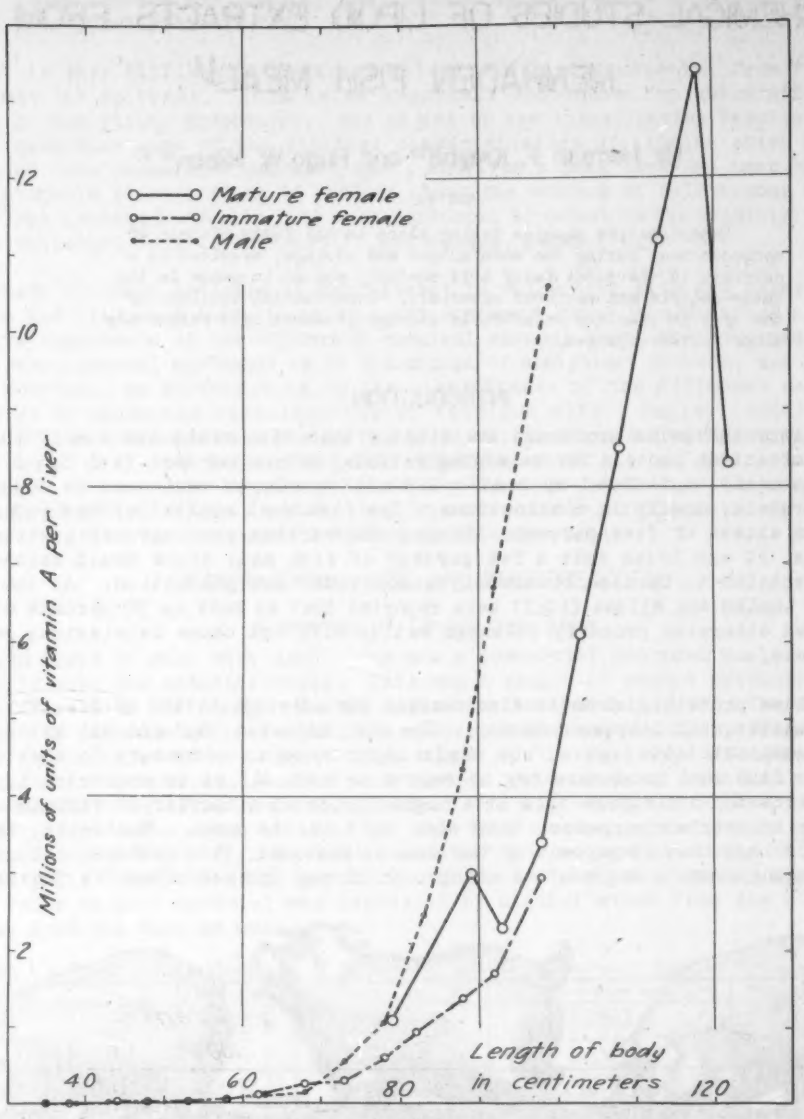


FIGURE 6 - RELATIONSHIP BETWEEN THE AMOUNT OF VITAMIN A IN EACH INDIVIDUAL LIVER AND BODY LENGTH

grayfish less than 30 in. long (76 cm.) and no female grayfish less than 36 in. long (91 cm.) be taken.

# CHEMICAL STUDIES OF LIPOID EXTRACTS FROM MENHADEN FISH MEAL[1/]

By Herman F. Kraybill* and Hugo W. Nilson**

ABSTRACT

Deteriorative changes taking place in the fatty protein of menhaden meal during the manufacture and storage, resulted in a decrease in the total fatty acid content, and an increase in the water-soluble and resinous materials. Experimental spoilage of the meal to simulate unfavorable storage produced only relatively minor further changes.

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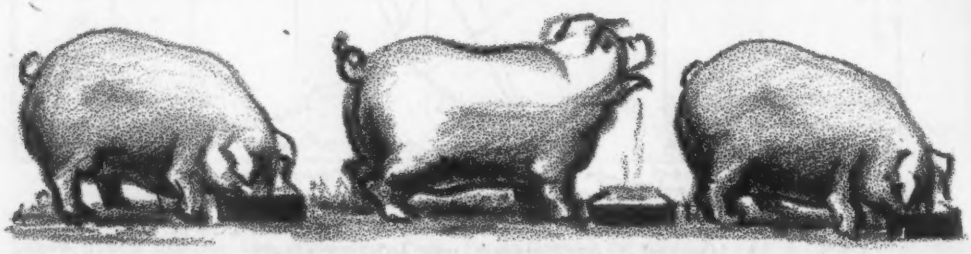
## INTRODUCTION

Poultry and swine producers are finding that fish meals are one of the best sources of animal protein for balancing rations. Before the war, fish meals, tankage, meat meals, and dried or semi-solid milk products were used as sources of animal protein, mostly in combinations. The fish meal content of the ration was seldom in excess of five percent. During the wartime shortages of protein concentrates, it was found that a few percent of fish meal alone would balance the cereal proteins to furnish reasonably good growth and production. At the other extreme, Lanham and Nilson (1947) have reported that as much as 30 percent of fish meal in an otherwise properly balanced ration will not cause deleterious results with chicks.

Besides protein, fish meals also contain variable quantities of oil, vitamins, mineral matter, and fibrous material. The oil, vitamins, and mineral matter contribute some nutritive value, but their importance is secondary to that of the protein. Fish meal producers try to remove as much oil as is economically practical, since the oil can be sold at a higher price as a carrier of vitamins A and D, or for industrial purposes, than when left in the meal. Generally, the oil content is less than 15 percent of the meal as marketed. This residual oil usually has undergone certain degradative changes which may produce offensive flavors and



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1/ The data in this paper were included in a thesis submitted by Dr. Herman F. Kraybill to the faculty of the Graduate School of the University of Maryland, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

NOTE: The authors wish to acknowledge the helpful assistance of Dr. W. C. Supplee of the University of Maryland in carrying on this research work.

odors. Some feeders are fearful that poisoning may result if meals containing highly decomposed oils are fed.

It is very difficult to extract all of the lipoid material from fish meal with most fat solvents. This is an important consideration which affects the choice of analytical procedures. The object of the investigation reported herein was to determine some of the chemical characteristics of lipoids which had been extracted from commercial menhaden meal, and from a meal that had been subjected to unfavorable storage so as to produce about the maximum of deleterious changes. Concurrent feeding tests with rats were conducted to determine the possible toxicity of the extracted materials (Kraybill and Nilson, 1946).

There are many articles in the literature which deal with the deterioration of fats and oils, and there is no apparent agreement among investigators as to the relative importance of the different chemical changes which are involved. There is not even general agreement as to the choice of analytical methods, and possibly more important, no agreement as to the significance of the different analytical variables in measuring deterioration of fats and oils. Bailey (1945) and the Office of the Quartermaster General (1945) have issued quite comprehensive reviews on the subject of deterioration of fats and oils, so no attempt will be made here to analyze or summarize the available data. The data obtained in this investigation are presented without attempting to corroborate or disprove any specific hypothesis as to the mechanism involved in deterioration.

## EXPERIMENTAL DATA AND INTERPRETATION

### Extraction of Lipoids from Meal

Two types of meal were used. One was a commercial menhaden meal such as is regularly sold for animal feeding. This was a sample of recent production which was obtained from the factory shortly before the tests were started. The other was a sample of the same meal which had been subjected to experimental spoilage, a process which was intended to cause a high degree of the same type of deterioration as would occur commercially under unfavorable conditions of heat and moisture. To accomplish this deterioration, the meal was moistened and allowed to remain damp for about three weeks at about 38° C. This treatment resulted in extensive bacterial and mold growth. The meal was dried at a temperature under 50° C. The data in Table 1 show that the composition of the two meals was similar except that about twice as much material was extracted by diethyl ether from the commercial meal as from the spoiled meal.

Table 1 - The Proximate Analysis of Commercial and Experimentally Spoiled Menhaden Meal

| Sample | Moisture | Protein (N×6.25) | Diethyl ether extract | Mineral matter |
|---|---|---|---|---|
| | Percent | Percent | Percent | Percent |
| Commercial | 9.20 | 59.37 | 11.42 | 17.32 |
| | 9.80 | 60.36 | 11.71 | 17.30 |
| Experimentally spoiled | 7.70 | 66.02 | 5.81 | 20.62 |
| | 7.72 | 64.61 | 5.39 | 20.69 |

This finding indicated that further study was needed to select a solvent which would more efficiently extract the oil from the fish meals. Conditions of extraction which would keep chemical changes to a minimum during the process also had to be determined.

Harrison (1931) and Oshima and Suguwara (1937) had reported a decrease in the ether-extract content of fish meals during storage. The latter authors stated that this decrease was due to the oxidation of fatty acids to ether-insoluble

products because they found a simultaneous decrease in the iodine and bromine values of the oil and a slight increase in the free fatty acid content. These workers found also that this ether-insoluble material was soluble in acetone and the greater part was also soluble in 20 percent aqueous solution of hydrochloric acid when the oil was heated in the acid. Hydrolysis with papain did not give the same results.

In order to minimize the possibility of chemical change during our extractions, either anhydrous sodium sulfate or calcium chloride was mixed with the meal before the various solvents were added and the extractions were carried out at refrigerator temperatures. Forty grams of meal were placed in an Erlenmeyer flask together with 10 grams of anhydrous sodium sulfate or calcium chloride. Two volumes of solvent were added, and the flasks were shaken and then permitted to stand for 24 hours at about 10° C. The solvent was decanted, and the extraction was repeated until the solvent remained colorless. At this stage, the extraction was

Table 2 - Data on the Quantity of Material Extracted from Commercial Menhaden Meal with Various Solvents in the Presence of Sodium Sulfate or Calcium Chloride at about 10° C.

| Solvent | Chemical | Material Extracted | Solvent | Chemical | Material Extracted |
|---|---|---|---|---|---|
| | | Percent | | | Percent |
| Acetone | sodium sulfate | 8.10 | Chloroform | sodium sulfate | 10.44 |
| " | | 7.25 | " | | 10.40 |
| " | calcium chloride | 4.33 | Ether, diethyl | sodium sulfate | 11.61 |
| " | | 4.47 | " | | 11.43 |
| Alcohol, ethyl | sodium sulfate | 10.91 | " | calcium chloride | 5.56 |
| " | | 10.61 | " | | 5.60 |
| " | calcium chloride | 4.40 | Ether, petroleum | sodium sulfate | 6.18 |
| " | | 4.86 | " | | 6.19 |
| Benzol | sodium sulfate | 8.01 | Solvent mixture 1/ | sodium sulfate | 12.51 |
| " | | 7.80 | " | | 12.36 |
| " | calcium chloride | 5.68 | Trichloroethylene | sodium sulfate | 8.84 |
| " | | 5.71 | " | | 8.66 |
| Carbon disulfide | sodium sulfate | 7.49 | | | |
| " | | 7.33 | | | |

1/ Benzol, 50; methanol, 25; and acetone, 25 percent by volume.

considered complete. The yield of extract was determined by drying to constant weight at 20° C. under vacuum. The data in Table 2 show that both the solvent and the added chemical affected the quantity of material extracted.

Table 3 - Data on Extraction at about 10° C. of Commercial and Experimentally Spoiled Menhaden Meal with Diethyl Ether and Solvent Mixture, Using Sodium Sulfate as a Dehydrating Agent

| Type of Product | Solvent | Material Extracted |
|---|---|---|
| | | Percent |
| Commercial meal | Ether | 9.98 |
| | Solvent mixture | 16.35 |
| Spoiled meal | Ether | 6.21 |
| | Solvent mixture | 16.80 |
| Ether extracted spoiled meal | Solvent mixture | 11.31 |
| Solvent mixture extract from spoiled meal | Ether | 5.99 |

A solvent mixture consisting of 50 percent by volume of benzol, 25 percent of methanol, and 25 percent of acetone extracted the most material. More extract was obtained with anhydrous sodium sulfate than with calcium chloride under these conditions. Solvent addition compounds were undoubtedly formed with calcium chloride.

The results presented in Table 3 (see p. 10) show that the solvent mixture extracted lipoid material equally well both from the commercial and spoiled meals. Apparently, products are formed during the experimental spoilage of the meal which can be extracted by the solvent mixture but not by diethyl ether.

## Effect of Storage Conditions

In order to estimate the degradation that occurs in the constitutive oil in the meal as affected by temperature, 25-pound samples of commercial meal were stored in paraffin-lined cans at temperatures of -23°, 25°, and 37.5° C. These temperatures cover the extreme range of practical storage conditions. Initially, and after storage periods of 3, 8, and 12 months, portions of each sample were extracted with the solvent mixture at 10° C. as described previously. The iodine and saponification numbers were used as the preferable criteria for following the trend of deterioration. The peroxide and aldehyde values seem less reliable indices, but did prove useful for comparative purposes.

Table 4 - Analytical Data on the Oil Extracted by the Solvent Mixture at about 10° C. from Samples of Commercial Menhaden Meal stored in Parrafin-Lined Cans at Various Temperatures

| Period of Storage and Temperature in °C. | AVERAGE VALUES | | | |
|---|---|---|---|---|
| | Iodine Number | Saponification Number | Peroxide Value | Fat Aldehyde Value |
| Initial sample: | | | | |
| -23 | 128 | 182 | 50 | 10 |
| 25 | 128 | 181 | 49 | 9 |
| 37.5 | 128 | 182 | 51 | 10 |
| After 3 months: | | | | |
| -23 | 126 | 185 | 71 | 13 |
| 25 | 126 | 189 | 69 | 12 |
| 37.5 | 122 | 194 | 114 | 11 |
| After 8 months: | | | | |
| -23 | 126 | 190 | 7 | 27 |
| 25 | 118 | 211 | 8 | 37 |
| 37.5 | 81 | 220 | 8 | 68 |
| After 12 months: | | | | |
| -23 | 116 | 194 | 8 | 7 |
| 25 | 113 | 218 | 9 | 7 |
| 37.5 | 68 | 228 | 9 | 12 |

Note: The iodine number was determined by the Hanus method (Association Official Agricultural Chemists, 1935). The saponification number was determined according to the method of the Association of Official Agricultural Chemists (1935).

The peroxide value was determined according to a modification of the Wheeler method as follows: 3 to 10 g. of oil are dissolved in 50 ml. of a mixture of glacial acetic acid and chloroform (3 to 2 by volume), and 1 ml. of saturated potassium iodide solution is added. Nitrogen gas is fed into the flask containing the reaction mixture, and the flask is rotated periodically. Better results are obtained if the flask is placed in an ice and salt bath. After 5 or 10 minutes, 50 ml. of water are added, and the titration is carried out immediately with 0.005N thiosulfate, starch being added as an indicator near the end point. The aldehyde value was determined according to the Schibsted (1932) method. This method was satisfactory for light-colored oils, but with dark-colored oils there was a masking effect which required comparing an orange red with a red color.

The data in Table 4 show that degradation proceeds at an accelerated rate in the extract after the first three months of storage. The rate appeared to be influenced by the temperature of storage, but chemical changes occurred even at -23° C. These changes were indicated by a decrease in the iodine number and an increase in the saponification number after three months of storage. There was a rather marked increase in the peroxide value. The extract from the meal stored at the highest temperature showed the greatest change.

After eight months of storage, the changes in the iodine and saponification numbers followed the pattern observed after three months of storage. There was, furthermore, a marked decrease in the peroxide value and a significant increase in the aldehyde value. After 12 months of storage, similar changes were again indicated in the iodine and saponification numbers. Both the peroxide and aldehyde values, however, were small.

The data suggest that there was an initial formation of peroxides, which were later destroyed with the production of aldehydes. These decomposed with the formation of free fatty acids.

A few experiments were carried out at a later date to identify the aldehydes. Qualitative tests with reagents such as fuchsin sulfurous acid and dimethyldihydroresorcinol indicated the presence of the aldehydes but did not identify them except for small amounts of acrolein and valeraldehyde.

## Analytical Data for Extracts

Fractionation studies were carried out with the several extracts and also with a sample of commercial, cold-pressed menhaden oil in order to determine what chemical changes took place in the oil during the preparation of the commercial and the experimentally spoiled meals. It must be emphasized, however, that only a single sample of menhaden meal was used. Time did not permit extracting other lots to determine what variability might be expected in the analytical data. The main concern was to determine the general nature of the changes to be expected during the preparation of commercial-grade fish meal and what the nature of further changes are during subsequent experimental spoilage.

FLASKS AND LIEBIG CONDENSER

A continuous extraction apparatus was used for extracting the oil from the fish meals. This consisted of a 12-liter, round-bottom flask supported on a sand bath heated by an electric hot plate. The round-bottom flask retaining the solvent was connected by means of a syphon tube to a Knightware ceramic extractor with a capacity of about 10 liters. A Liebig condenser for condensing the solvent was fitted to the top of the extractor. The solvent mixture was used since it extracted about the same quantity of material from both the commercial and spoiled meal.

With this apparatus, the extraction could be carried out rapidly with the possibility of relatively insignificant chemical changes in the extract; so the slower method of mixing the solvent with the meal and storing the mixture in the cold was not used. Precautions were taken to maintain a rapid rate of extraction under an inert atmosphere. The extracts were kept under an atmosphere of nitrogen in subsequent manipulations at any time that conditions favored degradative changes.

The two extracts and a sample of cold-pressed oil (the only sample of menhaden oil available at the time this study was carried out) were saponified with 2N alcoholic potassium hydroxide in accordance with the method of Mattill (1931) and Olcott (1932). The soaps were dissolved in water after the removal of the ethanol under reduced pressure and in an atmosphere of nitrogen. The unsaponifiable fraction was extracted with diethyl ether.

The soaps were acidified with 20 percent sulfuric acid, and the liberated fatty acids were extracted with diethyl ether. The fatty acids were separated into saturated and unsaturated fractions by the lead salt - alcohol method of Twitchell (1921).

The data in Table 5 show that the extracts from the two types of meal contained about 55 percent of total saturated and unsaturated acids, as compared with 88 percent in the cold-pressed oil. About one-third of the acids in the extracts and about one-fourth in the cold-pressed oil were saturated. The ratio of saturated to unsaturated acids found in the extracts is very similar to that reported by other investigators for menhaden oil when no mention was made of the degree of refinement. The iodine number of the unsaturated acids in the extracts was markedly less than for the unsaturated acids from the cold-pressed oil.

Table 5 - Yields and Iodine Numbers of the Various Fractions of Cold-Pressed Menhaden Oil and Extracts from Commercial and Experimentally Spoiled Menhaden Meal

| Source and fraction | Yield | | Iodine number | Source and fraction | Yield | | Iodine number |
|---|---|---|---|---|---|---|---|
| | Grams | Percent | | | Grams | Percent | |
| Cold-pressed oil: | | | | Commercial-meal extract (Cont.): | | | |
| Combined acids: | 443.0 | 88.1 | 176.6 | Water-soluble material | 142.2 | 28.0 | |
| Saturated | 112.9 | 25.5 | 5.3 | Resinous material | 75.0 | 14.8 | 37.0 |
| Unsaturated | 330.0 | 74.5 | 237.0 | Unsaponifiable matter | 15.0 | 3.0 | 69.0 |
| Water-soluble material | 43.5 | 9.8 | | Spoiled-meal extract: | | | |
| Resinous material | 0.2 | 0.1 | | Combined acids: | 289.0 | 55.6 | 60.0 |
| Unsaponifiable matter | 10.4 | 2.1 | | Saturated | 92.3 | 31.9 | 1.2 |
| Commercial-meal extract: | | | | Unsaturated | 197.0 | 68.2 | 100.0 |
| Combined acids: | 273.0 | 53.7 | 67.5 | Water-soluble material | 154.4 | 29.8 | |
| Saturated | 104.0 | 38.1 | 13.2 | Resinous material | 50.0 | 9.6 | |
| Unsaturated | 169.0 | 61.9 | 108.3 | Unsaponifiable matter | 26.0 | 5.0 | |

There was almost three times as much water-soluble fraction in the extracts as in the cold-pressed oil. The constituents of this fraction have not been identified, but some of them are undoubtedly such fatty acid degradation products as short-chain fatty acids and aldehydes.

An ether-insoluble fraction was obtained which is identified as resinous material in Table 5. This material was suspended as a tarry mass in the fatty acids after the latter were liberated with 20 percent sulfuric acid from the soaps of the cold-pressed oil and of the extracts from the meals. The resinous material became relatively hard and brittle on exposure to air after having been removed from the fatty acids by filtration. It had an iodine number of 37, indicating the possible presence of a small amount of unsaturated compounds. The resinous materials from the commercial and spoiled meal extracts also contained 1.50 and 2.78 percent nitrogen, respectively. This suggests that the resinous material is a mixed product of unsaturated glycerides and nitrogenous compounds.

The unsaponifiable matter amounted to 2.06 percent in the cold-pressed oil and 2.96 percent in the extract from the commercial meal. It is doubtful that this difference is significant. In the extract from the experimentally spoiled meal, 5.0 percent of this product was found. This difference is undoubtedly significant, and may be the result of a degradation of the resinous material through microbial action during spoilage of the meal.

The component fatty acids of the extracts from the commercial and spoiled menhaden meals were estimated in order to obtain additional information on the degradation of lipoids. This was accomplished by fractionation of the methyl esters derived from the saturated and unsaturated acids.

The methyl esters were prepared in the usual manner with absolute methanol and dry hydrogen chloride gas. The distillation apparatus consisted of a round-bottom distillation flask which was heated by an electric mantle. The flask was

Table 6 - Data on Yields, Mean Molecular Weights, and Iodine Numbers of Fractions Obtained from the Distillation of Methyl Esters of Fatty Acids from Commercial Menhaden Meal

| Fraction | Yield | Boiling point (0.5 to 1.0 mm) | Mean molecular weight | Iodine number | Unsaturation value 1/ |
|---|---|---|---|---|---|
| | Grams | °C | | | |
| Saturated fatty acids: 2/ | | | | | |
| 1 | 0.4 | 119 - 125 | 245.1 | 0.6 | |
| 2 | 1.0 | 125 - 135 | 248.9 | 0.4 | |
| 3 | 8.5 | 135 - 140 | 296.6 | 0.1 | |
| 4 | 6.8 | 140 - 144 | 273.9 | 0.0 | |
| 5 | 0.9 | 144 - 150 | 281.4 | 2.1 | |
| 6 | 3.1 | 150 - 165 | 295.4 | 2.1 | |
| 7 | 1.5 | 165 - 174 | 309.4 | 3.7 | |
| Residue | 4.6 | | 374.4 | 5.0 | |
| Unsaturated fatty acids: 3/ | | | | | |
| 1 | 2.3 | 129 - 135 | 238.8 | 23.5 | 0.44 |
| 2 | 2.9 | 135 - 140 | 252.1 | 39.1 | 0.77 |
| 3 | 8.1 | 140 - 145 | 264.2 | 86.4 | 1.60 |
| 4 | 2.5 | 145 - 152 | 271.0 | 83.6 | 1.78 |
| 5 | 6.2 | 152 - 156 | 276.9 | 93.9 | 2.05 |
| 6 | 3.1 | 156 - 160 | 283.6 | 102.2 | 2.28 |
| 7 | 2.7 | 160 - 165 | 286.2 | 100.5 | 2.29 |
| 8 | 6.6 | 165 - 172 | 294.8 | 101.2 | 2.35 |
| 9 | 0.9 | 172 - 180 | 324.1 | 113.1 | 2.88 |
| Holdup | 3.0 | 180 - 185 | 391.4 | 108.6 | 3.35 |
| Residue | 6.8 | | | 96.2 | |

1/ The unsaturation value equals iodine number divided by 100, times the mean molecular weight, divided by the atomic weight of iodine. This represents the mean number of hydrogen atoms required to completely saturate the unsaturated fatty acid molecule.
2/ With saturated fatty acids, 26.8 g. of esters were recovered from a total of 27.5 g.
3/ With unsaturated fatty acids, 45.2 g. of esters were recovered from a total of 47.0 g.

connected directly to a vertical, electrically-heated glass tube about three feet long which was filled with glass helices. A No. 6632 glass distillation head was fitted to the top of the tube. This head was designed for total reflux, and permitted partial take-off. All connections were standard-taper, ground-glass joints. The distillation was carried out under a pressure of 0.10 to 0.50 millimeter of mercury.

The data in Tables 6 and 7 permit an estimation of the component fatty acids from the mean molecular weight of the fractions (Table 8). It is believed that enough fractions of the methyl esters were separated to permit this interpolation from a nomograph calculated on the assumption that no fraction contained more than two fatty acids in a homologous series, and that the percentage distribution of the two acids was proportional to the mixed molecular weight. This method has been found useful in the estimation of approximate values, but cannot be depended upon to indicate actual distribution, especially for the unsaturated acids of higher molecular weights.

The data in Table 8 indicate that the conditions of manufacturing commercial fish meal alter the composition of the oil. There was a considerable increase in the quantity of $C_{16}$ and $C_{18}$ acids, and a decrease in the quantity of the $C_{14}$ saturated acids as compared with the analysis for menhaden oil reported by Stingley (1940). There was also an increase in the quantity of $C_{14}$ and $C_{16}$ acids, and a decrease in the quantity of $C_{18}$, $C_{20}$, and $C_{22}$ unsaturated acids. It is not possible

to determine exactly what happened to the different fatty acids during the production of the meal, but apparently the unsaturated acids having $C_{18}$ or more carbon atoms were decomposed to unsaturated acids of shorter molecular weight and to

Table 7 - Data on Yields, Mean Molecular Weights and Iodine Number of Fractions Obtained from the Distillation of Methyl Esters of Fatty Acids from Spoiled Menhaden Meal

| Fraction | Yield | Boiling point (0.5 to 1.0 mm) | Mean molecular weight | Iodine number | Unsaturation value[1] |
|---|---|---|---|---|---|
| | Grams | °C | | | |
| Saturated fatty acids:[2] | | | | | |
| 1 | 3.2 | 119 - 124 | 250.9 | 1.5 | |
| 2 | 3.2 | 124 - 134 | 265.8 | 1.8 | |
| 3 | 5.9 | 134 - 139 | 271.2 | 0.0 | |
| 4 | 7.4 | 139 - 140 | 266.6 | 3.6 | |
| 5 | 3.7 | 140 - 142 | 275.1 | 2.5 | |
| 6 | 4.9 | 142 - 165 | 275.7 | 0.9 | |
| 7 | 3.0 | 165 - 174 | 289.9 | 0.9 | |
| Residue | 3.5 | | 329.7 | 5.1 | |
| Unsaturated fatty acids:[3] | | | | | |
| 1 | 0.5 | 118 - 125 | 213.2 | 33.7 | 0.56 |
| 2 | 1.9 | 125 - 130 | 231.2 | 35.6 | 0.65 |
| 3 | 1.2 | 130 - 135 | 250.5 | 36.3 | 0.72 |
| 4 | 2.8 | 135 - 140 | 255.8 | 37.2 | 1.15 |
| 5 | 4.1 | 140 - 145 | 262.0 | 76.8 | 1.59 |
| 6 | 3.8 | 145 - 150 | 280.8 | 77.2 | 1.71 |
| 7 | 5.3 | 150 - 159 | 299.5 | 96.0 | 2.27 |
| 8 | 4.0 | 159 - 165 | 322.8 | 109.6 | 2.78 |
| 9 | 3.2 | 165 - 170 | 360.1 | 124.7 | 3.54 |
| 10 | 0.8 | 170 - 175 | 424.4 | 113.6 | 3.80 |
| Holdup | 2.6 | | | | |
| Residue | 2.5 | | | | |

1/ The unsaturation value equals iodine number divided by 100, times the mean molecular weight, divided by the atomic weight of iodine. This represents the mean number of hydrogen atoms required to completely saturate the unsaturated fatty acid molecule.
2/ With saturated fatty acids, 35.8 g. of esters were recovered from a total of 36.4 g.
3/ With unsaturated fatty acids, 32.7 g. of esters were recovered from a total of 36.5 g.

saturated acids. Undoubtedly, some of the so-called saturated acids are oxidized acids which do not absorb iodine and are, therefore, not true saturated fatty acids. Part of the unsaturated acids may also have been decomposed to form the

Table 8 - Data on the Component Fatty Acids in the Total Acids Extracted from Commercial and Experimentally Spoiled Menhaden Meal, as Calculated from the Mixed Molecular Weights of the Methyl Esters

| Source of total acids | Acids, percent by weight | | | | | | |
|---|---|---|---|---|---|---|---|
| | $C_{12}$ | $C_{14}$ | $C_{16}$ | $C_{18}$ | $C_{20}$ | $C_{22}$ | $C_{24}$ |
| Saturated: | | | | | | | |
| Commercial meal | 0.0 | 1.9 | 21.5 | 5.8 | 0.8 | 1.8 | 4.6 |
| Spoiled meal | 0.0 | 3.2 | 20.6 | 3.4 | 2.7 | 0.4 | 0.0 |
| Menhaden oil[1] | - | 7.0 | 16.0 | 1.0 | - | - | - |
| Unsaturated: | | | | | | | |
| Commercial meal | 0.4 | 8.5 | 28.7 | 20.0 | 1.5 | 0.0 | 0.0 |
| Spoiled meal | 4.0 | 9.4 | 17.1 | 15.5 | 11.0 | 5.3 | 2.6 |
| Menhaden oil[1] | - | trace | 17.0 | 27.0 | 20.0 | 12.0 | - |

1/ Data reported by Stingley (1940).

water-soluble material reported in Table 5. Under these circumstances, it is not possible to determine what changes are due to hydrolysis, hydrogenation, or oxidation.

The experimental spoilage of the commercial meal by means simulating unfavorable storage produced relatively minor further changes in the fatty acid components of the oil. There was a six percent decrease in the quantity of saturated acids as compared with the extract from commercial meal, with an approximately equal increase in the quantity of the unsaturated acids. There was a decrease in the content of the $C_{24}$ saturated acids and the $C_{16}$ and $C_{18}$ unsaturated acids. There was an increase in the quantity of the $C_{12}$, $C_{20}$, $C_{22}$, and $C_{24}$ unsaturated acids. It is rather difficult to explain the increase of $C_{20}$ to $C_{24}$ unsaturated acids except that they were synthesized from shorter-chain acids by bacteria and molds. It is interesting to note that 0.02 percent of $C_{10}$ (not reported in Table 8), and 4.0 percent of $C_{12}$ unsaturated acids were found in the spoiled-meal extract. Unsaturated acids of this length have been seldom reported as being present in foods.

A quantitative determination of total lipoid material by the method of Bloor (1926) was also carried out. The data in Table 9 show that the commercial-meal

Table 9 - Data on the Yield, Color, and Iodine Numbers of Lipoid Fractions Obtained from a 100-gram Sample of Commercial Menhaden Meal

| Fraction | Yield | Calculated on Basis: Dry meal | Calculated on Basis: Total extract | Color | Iodine number |
|---|---|---|---|---|---|
| | Grams | Percent | Percent | | |
| Alcohol-ether extract | 12.76 | 14.14 | - | Dark brown | 105 |
| Combined phospholipides | 1.90 | 2.10 | 14.85 | - | - |
| Lecithin | 1.79 | 1.98 | 14.02 | Light brown | 120 |
| Cephalin | 0.11 | 0.12 | 0.83 | Yellow white | 195 |
| Acetone extract | 7.83 | 8.68 | 61.38 | Brown red | - |
| Fatty acids | 7.51 | 8.33 | 58.90 | Yellow | 93 |
| Unsaponifiable matter | 0.34 | 0.38 | 2.69 | Brown | - |
| Ether-insoluble matter | 1.53 | 1.69 | 12.00 | Light brown | 138 |

extract contained about 12 percent ether-insoluble material. This was found to be a resinous material quite similar in quantity and appearance to that reported in Table 5. The iodine numbers for the lecithin and cephalin fractions were rather high, indicating that the fatty acid fragments in the compounds must be highly unsaturated.

## DISCUSSION

The data on iodine values in Table 5 indicate that considerable degradation of oils takes place during the manufacture of the meal. This conclusion is confirmed by the data in Table 8 on the estimated component fatty acid content of the extract. There was a less significant change as a result of experimental spoilage to simulate the effects of unfavorable storage. Aside from a change in the fatty acid composition, degradation of oil definitely promotes the combination of some of the constituents of the oil with protein break-down products to form resinous material. This material amounts to about 15 percent of the extract from commercial meal. There is also a fragmentation of the fatty acids to increase greatly the content of water-soluble material. The latter two components have not been identified. It is suggested that considerable new information on the mechanism of the degradation of oils could be obtained if these identification studies were completed.

It is recognized, of course, that simultaneous chemical changes occurred in the protein of the meal. These changes were probably not very extensive during the manufacture of the commercial meal, but most certainly considerable degradation took place during the experimental spoilage. The spoiled meal had a very foul odor and also smelled strongly of ammonia.

In general, it may be surmised that the chemical changes which took place in the lipoids of the commercial meal were a result of reactions begun during the initial steam-cooking process, and were likely due to the later drying of the pressed fish scrap to produce the dry, commercial meal. Degradation reactions initiated in these manufacturing steps, however, continued during storage under conditions which did not promote marked decomposition of protein, the rate being influenced by the temperature of storage and undoubtedly by other environmental factors (Table 4). The differential changes which were found to have taken place in the lipoids of the experimentally spoiled meal were more probably due to the hydrolytic and synthetic actions of bacteria and molds.

## SUMMARY

1. A solvent mixture consisting of 50 percent by volume of benzol, 25 percent methanol, and 25 percent acetone produced the highest yield of extract from fish meals, regardless of the degree of deterioration of the oil.

2. Deteriorative changes taking place during the manufacture and normal storage of the meal resulted in a decrease in the total fatty acid content, and an increase in the water-soluble and resinous materials.

3. Experimental spoilage of the meal to simulate unfavorable storage produced relatively minor changes in the fatty acid composition. There was a decrease in the quantity of the saturated acids with a corresponding increase in the unsaturated acids. There was also an increase in the unsaponifiable matter and a decrease in resinous material, as compared with the extract from the commercial meal.

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## BALLOON TRAWL CONSTRUCTION

(LONG ISLAND TYPE)

Several kinds of balloon trawls are used successfully along the Atlantic Coast for catching butterfish, porgy, weakfish, etc. These trawls are constructed much the same as the so-called "flat" net which is used in trawling for flounder and fluke, except that in the balloon trawl enough fullness is built into the wedge or gore to allow the net a higher opening at the mouth. As a result of the higher opening, the balloon trawl will take fish which are at times off the bottom a sufficient distance to allow them to escape a "flat" trawl.

Like any other fishing gear, balloon trawls vary considerably in accordance with the individual operator's ideas of the best design and construction to fit his particular circumstances. The trawl described in this leaflet is one of the types used in Long Island waters by small dragger vessels usually about 35 to 45 feet in length. Larger vessels with greater propulsion power use larger balloon trawls, but the trawl specified herein is well fitted for use with the smaller type of vessel.

--Fishery Leaflet 245

# STUDIES ON METHODS OF EXTRACTING VITAMIN A AND OIL FROM FISHERY PRODUCTS[1/]

## PART I - VITAMIN A POTENCIES OF OILS FROM GRAYFISH LIVERS OBTAINED BY EXTRACTION WITH PETROLEUM ETHER AND BY COOKING WITH WATER

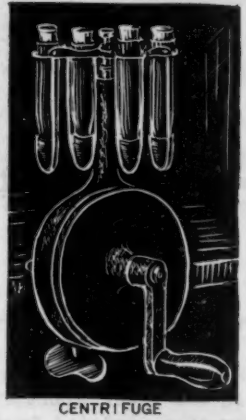
By D. Miyauchi* and F. B. Sanford*

ABSTRACT

Grayfish livers held at different temperatures were extracted with petroleum ether and by cooking with water. The vitamin A content of the oil extracted with petroleum ether was about one percent higher than for the oil extracted by cooking with water.

- - - - -

Incidental to an experimental study on the deterioration of vitamin A in stored grayfish livers,[2/] analytical data were obtained whereby a comparison could be made of the vitamin A potencies of the liver oils extracted with petroleum ether and water. In the analysis of the vitamin A content of fish livers, it is customary to extract the vitamin A and oil from the livers by solvent extraction.[3/] However, in special instances, it is desirable to render the oil and vitamin A from the livers by cooking them with water. This report presents the values for vitamin A content when these two methods of extraction were used.



CENTRIFUGE

In this experiment, approximately 30 pounds of fresh grayfish livers were passed through a meat grinder, stirred until homogeneous, and filled into pint Mason jars. After the jars were covered, they were divided into three groups. The first group was stored at room temperature (23° C.). The second group was stored in melting ice (0° C.), and the third group was stored in a sharp freezer (-22.5° C.).

At the start of the storage period and periodically thereafter, two or three jars of ground grayfish livers from each of the three groups were opened for examination. The contents of each jar was made homogeneous by means of a Waring blendor, and duplicate samples of three to five grams were weighed in shaking bottles. After adding 25 milliliters of petroleum ether and one teaspoon of anhydrous sodium sulfate, the bottles were placed in a shaking machine for approximately one hour and then centrifuged until a clear solvent layer was obtained. The oil in the petroleum ether layer was used to determine the vitamin A potency of the liver material in each jar.

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1/This is the first of a series of articles on this subject. Others will appear in subsequent issues.

2/Studies on the Deterioration of Vitamin A in Fish Livers and Liver Oils. Part I - Loss of Vitamin A and Stability in Grayfish Livers in Storage, by F. B. Sanford, D. T. Miyauchi, and G. I. Jones. Commercial Fisheries Review, February 1947, pp. 11-15.

3/Preliminary Procedures for the Analysis of Vitamin A in Fishery Byproducts. Commercial Fisheries Review, January 1947, pp. 40-42.

Liver samples from the same lot were placed in a large beaker and an equal amount by weight of hot water was added to it. After cooking in a water bath for about 20 minutes, the mixture was centrifuged until the oil separated to the top. A layer of anhydrous sodium sulfate was placed over a filter paper in a funnel, and the oil was filtered through it to remove any traces of moisture and suspended solids. The vitamin A potency of the water-extracted oil was determined by duplicate analyses, by spectrophotometric methods, and the average potency was calculated.

The average vitamin A potencies of the solvent-extracted oil and of the water-extracted oil analyzed at the end of each storage period are recorded in Table 1.

Table 1 - The Vitamin A Potencies of Oils Extracted by Petroleum Ether and Water

| Period of Storage | AVERAGE VITAMIN A POTENCY | | Difference in Potency Between Water Extracted and Solvent Extracted Oils |
|---|---|---|---|
| | Solvent Extracted Oil | Water Extracted Oil | |
| Days | USP Units Per Gram | USP Units Per Gram | Relative Percent |
| Storage at Room Temperature (18° to 27° C., average = 23° C.) | | | |
| 0 | 14,215 | 14,280 | +0.46 |
| 7 | 14,380 | 13,960 | -2.92 |
| 14 | 14,288 | 14,000 | -2.02 |
| 21 | 14,316 | 14,165 | -1.06 |
| 28 | 14,504 | 14,265 | -1.65 |
| | | | Average = -1.91 |
| Storage in Ice 0° C. | | | |
| 22 | 14,309 | 14,070 | -1.67 |
| 29 | 14,437 | 14,105 | -2.30 |
| 43 | 14,350 | 14,250 | -0.70 |
| | | | Average = -1.56 |
| Storage in Refrigerator (-28° to -20° C., Average = -22.5° C.) | | | |
| 23 | 14,356 | 14,290 | -0.46 |
| 49 | 14,400 | 14,315 | -0.59 |
| 189 | 14,065 | 14,274 | +1.49 |
| 287 | 14,116 | 13,960 | -1.10 |
| | | | Average = -0.16 |
| | | Average Difference of the 12 analyses = | -1.04 |

In 10 out of the 12 analyses, the average vitamin A potency of the water-extracted oil was lower than that of the solvent-extracted oil. The deviation was the largest for oils rendered from livers stored at room temperature and the smallest for oils rendered from livers stored in the refrigerator. The average deviation for all the samples was -1.04 percent. Statistical analyses showed that an average deviation of -1.04 percent is significant.

# TECHNOLOGICAL RESEARCH IN SERVICE LABORATORIES

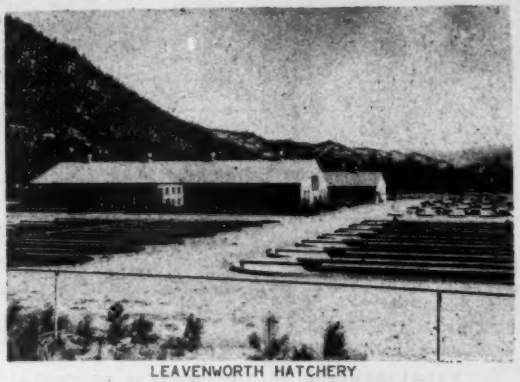
## JULY 1947

## Seattle, Wash.

Six sea lampreys, now a numerous and predatory fish in the Great Lakes, were analyzed for oil and vitamin A content. Both the oil and vitamin A contents were so low that processing the fish for these products is not feasible.

* * *

Preliminary digestion by acid or alkali of livers containing little oil and vitamin A, did not increase the yield of either in subsequent extraction with solvents. This work was part of the project to develop better methods of analyses for different types of livers.



LEAVENWORTH HATCHERY
SHOWING BUILDINGS AND FISH PONDS

* * *

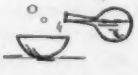
A staff member just completed a 6-week trip to the Middle West and the East during which he contacted many pharmaceutical houses, specialty chemical factories, and research laboratories. Much information was obtained on possible needs for products which may be derived from salmon cannery wastes.

* * *

Feeding tests with fish were begun at the Leavenworth, Washington, hatchery using products made from salmon cannery wastes.

## Boston, Mass.

A summary of research data was compiled on the bacterial population of brining tanks in filleting plants. A meeting will be held in the near future with interested members of industry to discuss the results.



## College Park, Md.

Work was begun on a fibreboard container for possible use in shipping frozen foods on unrefrigerated carriers.

* * *

Experimental packs of canned crab meat cakes and gumbo were prepared.

* * *

Further tests were conducted on the antibiotic activity of several extracts made from fishery products.

* * *

A series of canned spreads satisfactory for sandwich spreads were made from fishery products.

## Ketchikan, Alaska

An Alaska seafood buffet, consisting of canned or frozen samples of fishery products prepared in the laboratory, was served to determine consumer acceptability, storage qualities, and canning characteristics of the new products.

* * *

Final testing of the canning characteristics of salmon cannery trimmings was started.

* * *

An exhibit, lecture, and demonstration on the home canning of halibut fillets was conducted for 27 members of the Home Makers Club.

* * *

Equipment was procured and the collection of waste was begun for use in the study of the utilization of salmon cannery waste.

### CURTAILED TECHNOLOGICAL PROGRAM

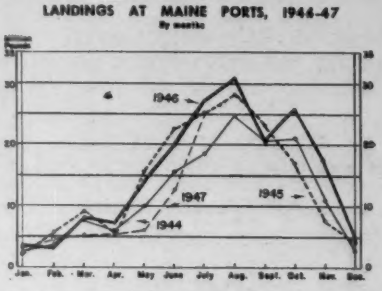
The Service regrets the loss of a number of its competent and loyal war service and temporary employees from its Washington staff and field laboratories because of a 44 percent cut in appropriations for the current fiscal year. It wishes to express its appreciation for the character of the work they have accomplished while with the Service. Their ability and the importance of their work has been demonstrated by the immediate placements secured by those terminated.

Technological activities will be practically terminated at Mayaguez, and considerably curtailed at the Boston, Ketchikan, College Park, and Seattle laboratories. Use of the four mobile laboratories will likewise be severely restricted.

# FRESH AND FROZEN FISH

## New England

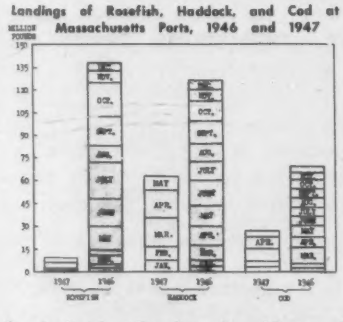
MAINE LANDINGS: Maine fishermen landed 25,001,000 pounds of fishery products, valued at $1,171,205, during July bringing the total for the first seven months of the year to 63,802,000 pounds, valued at $4,704,269, according to Current Fishery Statistics No. 365. This represents a decrease of 23 percent in volume and 28 percent in value as compared with the landings during the first seven months of 1946, which totaled 83,254,000 pounds, valued at $6,521,029.




The decreases were due largely to the reduced landings of herring, cod, rosefish, clams, lobsters, and sea mussels.

During July, landings at Portland amounted to 4,963,000 pounds, valued at $139,437 to the fishermen, and represent the largest landings of any month during the year.

* * * * *

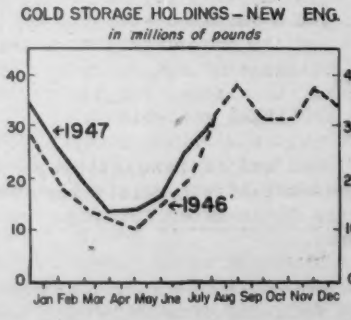



MASSACHUSETTS LANDINGS: Landings of fish and shellfish at the ports of Boston, Gloucester, New Bedford, Provincetown, and other Cape Cod ports during May amounted to 40,530,000 pounds, valued at $2,711,088 to the fishermen, according to Current Fishery Statistics No. 363. These landings brought the total for the first five months of 1947 to 139,777,000 pounds, valued at $11,357,848.

Comparisons of the 1947 and 1946 landings are inconclusive due to various economic and labor conditions, which, last year, so seriously affected the Boston landings, and, this year, have contributed to the curtailment of the Gloucester landings.

* * * * *

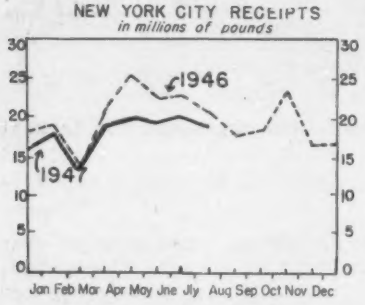
COLD STORAGE: Frozen fish and shellfish holdings in New England warehouses on August 1 amounted to 29,705,000 pounds, according to reports received by the Boston Fishery Market News Office. This was a 19 percent increase over the holdings on July 1, but 3 percent less than the holdings on August 1, 1946. This is interesting in view of the fact that on August 1, this year, the New England holdings comprised 27 percent of the national holdings, while on August 1, last year, they constituted but 24 percent of the total.



Of the three sections from which this information is derived, Boston, Gloucester, and the rest of New England, only Boston shows holdings in excess of those of August 1, 1946. Despite this fact, Boston's holdings are 3 percent less, as compared with the New England total, than they were on July 1, while Gloucester's are 3 percent more. Holdings in the other New England warehouses are 26 percent of the total, the same as they were last month.

## Middle Atlantic

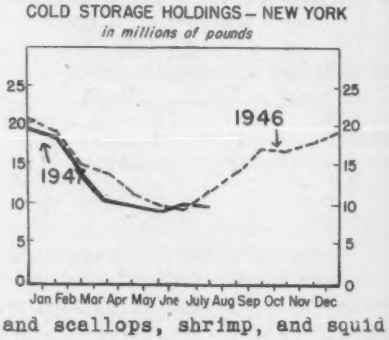
NEW YORK CITY ARRIVALS: Receipts of fish and shellfish at New York's Fulton Market during July 1947 totaled 18,208,000 pounds, according to the Service's Market News Office. This represents a decrease of a little more than 1⅛ million pounds under total receipts for June. During July 1946, total receipts amounted to slightly over 20,300,000 pounds. Approximately 63 percent of the July 1947 receipts was fresh and frozen fish.




Outstanding items were scup, mackerel, flounder, cod, haddock, whiting, yellowtails, and halibut. Leading items in the shellfish group were hard clams, shrimp, sea scallops, lobsters, hard crabs, soft crabs, and squid.

* * * * *

NEW YORK CITY COLD-STORAGE HOLDINGS: Holdings of frozen fish and shellfish in the New York City metropolitan area on August 1 totaled 8,088,000 pounds, a decrease of 7 percent compared with the previous month, and a decrease of 29 percent compared with the same period in 1946, according to the local Fishery Market News Office. Holdings of salt-water fish on August 1 were 6,410,000 pounds, compared with 8,579,000 pounds on August 1, 1946. Fresh-water and shellfish items on similar dates were 700,000 pounds and 1,414,000 pounds, and 978,000 pounds and 1,345,000 pounds, respectively.




The decline in the holdings for August 1, 1947, when compared with the holdings for August 1, 1946, is due largely to a sharp reduction in the holdings of cod fillets for the salt-water stocks; in ciscoes for the fresh-water species; and scallops, shrimp, and squid for shellfish varieties.

Cod and haddock fillets, mackerel, halibut, and salmon account for approximately 65 percent of the salt-water items; carp, sturgeon, and whitefish for 67 percent of the fresh-water holdings; and shrimp and squid, 74 percent of the shellfish stocks.

Holdings of all fish and shellfish, as of August 1, 1947, show a sharp reduction from the abnormally high holdings of 1946. Holdings on August 1, 1941 (1941

being the last full prewar year) were only 6,079,000 pounds, which would indicate that the 1947 holdings are well above what was once considered normal.

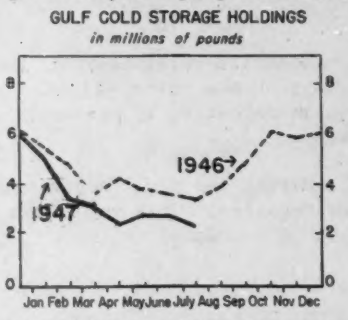
## Gulf

PRODUCTION: Because funds for operating the New Orleans Fishery Market News Office were not made available until late in the month, no data on fish and shellfish landings were obtained by the New Orleans office for the period July 1 to July 26.

Landings of shrimp caught in outside waters during July were confined to Alabama and Texas, as a closed season was in effect in Mississippi and Louisiana until August 11 for both inside and outside waters. Inside or inland waters were closed to commercial shrimping during July in Alabama and Texas.

* * * * *

COLD STORAGE: Eleven cold-storage warehouses in Alabama, Mississippi, Louisiana, and Texas reported holdings of frozen fish and shellfish amounting to 2,101,000 pounds on July 31, 11 percent less than four weeks previous, and 38 percent less than one year ago, according to the New Orleans Fishery Market News Office.




Frozen shrimp holdings on July 31 amounted to 375,000 pounds. During the previous four weeks, withdrawals exceeded the "in" movement by 244,000 pounds. On August 1, 1946, shrimp holdings were 1,005,000 pounds.

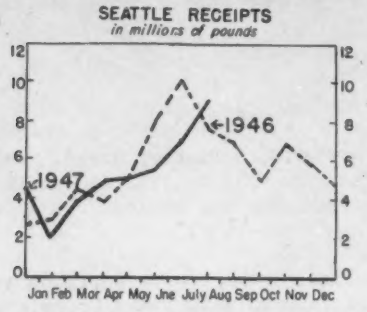
Salt-water fish holdings on July 31 were 1,309,000 pounds--104,000 pounds less than four weeks earlier, and 827,000 pounds less than one year ago. During the four weeks prior to July 31, withdrawals exceeded the "in" movement for rosefish fillets; flounder, sole, etc.; Spanish mackerel; cod fillets; red snapper; and several other species. In comparison to holdings last year, most varieties show a reduction. Those accounting for the largest decline were cod fillets, rosefish fillets, whiting and king whiting, blue runner, Spanish mackerel, and sea trout.

## Pacific

ARRIVALS: Seattle's receipts of fresh and frozen fishery products during the month of July totaled 9,111,000 pounds, according to the Service's local Market News Office. These receipts were about a third more than June but over 2½ million pounds less than July 1946.

Fishing for salmon continued excellent in practically all areas and receipts of these fish led all others. Deliveries from local sources, alone, accounted for well over 2,155,000 pounds, followed by British Columbia imports of 1,087,000 pounds, and Alaska shipments of 290,000 pounds, making a total of 3,532,000 pounds

which accounted for 39 percent of the port's total volume. This was nearly a million pounds more than the June deliveries. Of the total, king salmon accounted for 2,823,000 pounds, and silvers, 697,000 pounds. Incidentally, almost all these fish were taken by troll gear.




Second in importance was halibut. The Seattle fleet landed 1,275,000 pounds of fresh halibut during the month, making 24 trips to Area III and 2 trips to Area II. The latter trips also delivered 23,000 pounds of sablefish and 500 pounds of rockfishes. Additional deliveries from Alaska and British Columbia raised the halibut total to 2,844,000 pounds. The late start of the local fleet was largely responsible for the fact that receipts to date were nearly one-third less than for the same period in 1946.

In third and fourth places, respectively, were flounders and soles, totaling 909,000 pounds, and livers, 406,000 pounds.

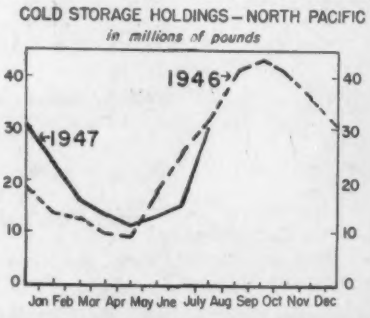
The local otter trawl fleet landed 1,668,000 pounds during July, making 68 trips to the offshore grounds. This was an increase of more than half a million pounds over June. Petrale sole, lingcod, and rockfishes made up the greater portion of the trawl receipts.

Domestic receipts of all items amounted to 5,687,000 pounds, accounting for 62 percent of the total volume. Alaskan sources contributed about 20 percent and British Columbia, 18 percent. Seventy-eight percent of all receipts was received fresh.

During the first seven months of 1947, a little more than 37,501,000 pounds were received. This was about 16 percent below the 1946 seven-month's total of 44,850,000 pounds.

* * * * *

NORTHWEST COLD STORAGE: Cold-storage holdings of fishery products in the Northwest region on August 1 increased over 11½ million pounds, or nearly 66 percent, according to the Service's Seattle Market News Office. Stocks of frozen fish and shellfish in 33 warehouses in Washington, Oregon, Alaska, and Prince Rupert, British Columbia, totaled 29,181,000 pounds, about 4 percent under the August 1, 1946 holdings of 30,502,000 pounds.




Heavy freezings of halibut and salmon in Washington and Alaska, and tuna in Oregon accounted for the sharp increase. There were nearly 6½ million pounds of halibut frozen, with Alaska plants accounting for about five-sixths of this amount. Salmon freezings amounted to well over 3 million pounds with the bulk again credited to Alaska. Indicative of the good tuna catches reported off the Oregon coast were the freezings of 4,578,000 pounds of this species. All but about 135,000 pounds were frozen in the Astoria area. Since about 95 percent of the tuna catch in the

Northwest is usually canned, most operators endeavor to freeze as much of the tuna as possible to keep cannery operations busy during the fall slack period. Receipts of fresh king and silver salmon were heavy in most areas and heavy quantities of these species, well over a million pounds each, were frozen to satisfy the expected winter demand.

The region's warehouses reported heaviest holdings for halibut, 14,608,000 pounds; salmon, all species, 4,630,000 pounds; tuna, 4,332,000 pounds; sablefish, 1,864,000 pounds; and bait and animal food, 1,237,000 pounds.

Cured fish stocks rose from 2,680,000 pounds on July 1 to 4,033,000 pounds. Mild-cured salmon, amounting to 3,217,000 pounds, accounted for 80 percent of the cured total. There were also more than half a million pounds of miscellaneous salted fish in storage. Practically all of the cured fish was held in Washington warehouses.

## Great Lakes

COLD STORAGE: Holdings of fishery products in Chicago cold-storage warehouses on July 31 amounted to 5,660,000 pounds, an increase of 4 percent over holdings on July 2, but represent a decline of 12 percent from holdings on August 1, 1946, according to the Service's Chicago Market News Office.

Holdings of fresh-water items increased 12 percent during July but were 31 percent below fresh-water holdings on August 1, 1946. Salt-water holdings on July 31 were 11 percent above those of July 2 and 1 percent above holdings of salt-water items a year ago. Shellfish holdings declined 28 percent during July and were 18 percent below shellfish holdings on August 1, 1946.

Withdrawals of fresh-water items were consistently light throughout July as arrivals, except for a few species, kept pace with the demand which was mostly light to moderate for the greater part of the month. Greatest gains among fresh-water holdings were made by chubs, 165 percent; lake trout, 22 percent; and yellow pike and yellow pike fillets, 57 percent. During the month, large quantities of whitefish were frozen by dealers, in their own freezing facilities, and shipped. These fish were shipped chiefly to southern States.

Withdrawals of salt-water items just about kept pace with receipts as few items showed much of a fluctuation. Holdings of fillets, all species, gained 3 percent during the month; halibut gained 45 percent; and salmon, 3 percent.

Holdings of shrimp declined 32 percent during July. Compared with shrimp holdings on August 1, 1946, the current holdings represent a decline of 30 percent.

An over-all review of cold-storage holdings shows few changes for the past 4 months, as the July 31 total is only 600,000 pounds above the April 1 total.

Species have fluctuated weekly from high to low according to the demand for individual items, but the general total changed very slowly. There has been some reluctance upon the part of public warehouses to freeze fresh fish for storage. No report has been received that there was unwillingness to hold fishery products already frozen, but dealers exhaust every possible means to store or sell surplus arrivals of fresh fish before resorting to public warehouses. This is also reflected by the unusual amounts of frozen fillets, halibut, salmon, and shrimp stored on the dealers' premises.

It has been noted of late that many carloads of frozen fish from the West Coast have been stopped in Chicago for part unloading, the rest of the load being re-dispatched to some other point, usually eastern. This is probably due to price differentials.

While not borne out by any definite information, it appears that most local dealers are united in an effort to prevent choice fisheries items such as lake trout, whitefish, and yellow pike from soaring to former high levels. It is observed that while lake trout have not been too abundant during the past month, the price remained stable at 46-48 cents. Not long ago a scarcity of lake trout would send the price up to 65 cents. Whitefish sold consistently under 30 cents and reached a low of 12 cents during June. With a gradually falling production, whitefish sold between 22 and 26 cents; while yellow pike have been fairly stable at 26 to 32 cents, regardless of receipts.

The summer months have been marked, so far, by almost no deliveries of frozen fresh-water fish. During past years, receipts of frozen items formed an important part of the weekly receipts. These days a frozen shipment is the exception.

* * * * *

RECEIPTS: Receipts of fresh and frozen fishery products in the Chicago wholesale market during July totaled 8,302,000 pounds. This was an increase of 2 percent compared with June and a decline of 2 percent compared with July 1946, according to the local Fishery Market News Office.

Compared with June, fresh-water receipts showed a decline of less than one-half of 1 percent but were 11 percent greater than the fresh-water receipts during July 1946. Salt-water receipts exceeded those of June by 26 percent but were 14 percent below those of July 1946. Shellfish deliveries were 38 percent below those of June but were 2 percent greater than July 1946.

Chief reasons for the small change in fresh-water fish deliveries was the continued large arrivals of lake trout, whitefish, and yellow pike. While these species fluctuated somewhat in daily importance, they again formed the three leading items for the month. Although some of the less desired items such as carp, lake herring, sheepshead, and suckers fell off in poundage, heavier arrivals of chubs and yellow pike, aided somewhat by increased arrivals of whitefish and pickerel, offset this decline.

Arrivals of lake trout, while still important, fell off 20 percent from the June total. They were also 16 percent below arrivals in July 1946. Yellow pike,

chiefly from Minnesota and Manitoba, arrived in quantities 26 percent greater than in June and exceeded the yellow pike receipts of July 1946 by 141 percent. Whitefish receipts exceeded those of June by 8 percent and were 59 percent greater than the total during July 1946.

The rise in salt-water fish receipts was due chiefly to the resumption of fishing by the Pacific Coast halibut fleet and the resultant increase in arrivals of halibut, both fresh and frozen, from West Coast ports, chiefly Prince Rupert. The July arrivals of halibut were 21 percent below those of July 1946. This was due to the lack of halibut fishing operations by Seattle fishermen until shortly after July 1 when differences between vessel owners and the fishing crews were settled and the fleet put to sea. Due to these conditions, arrivals of halibut from the West Coast did not attain importance until the latter part of July.

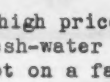
Arrivals of rosefish fillets from the East Coast of the United States and the Maritime Provinces were 80 percent greater than the arrivals during June; cod and cod fillets exceeded the previous month by 48 percent; haddock and haddock fillets declined 35 percent; and whiting, all items, declined 52 percent during the same period.

Arrivals of Pacific Coast salmon, chiefly kings and silvers, while comparable in quantity to those of June, were 58 percent below total salmon receipts during July 1946.

Total shrimp receipts during July were 40 percent below those of June and 6 percent below July 1946. Fresh shrimp formed only 4 percent of the July shrimp receipts while during June, they approximated 26 percent. During July 1946, fresh shrimp formed 32 percent of all shrimp arrivals. While other shellfish items arrived in quantities below those of June, no one item was outstanding and the July 1947 arrivals compared favorably with those of July 1946.

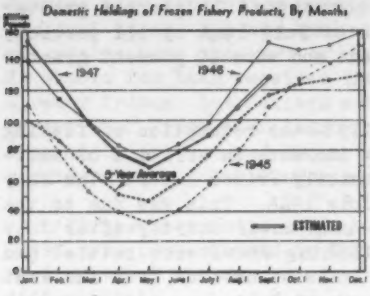
Very unstable price conditions affected the local halibut market during July and appeared to be so unsettled that the same conditions might apply to the whole season. Chicago Market News reports were watched very closely by local dealers throughout the month and mounting prices paid to fishermen were sharply reflected by increasing prices on halibut and salmon quoted by local dealers.

Shrimp maintained their usual high prices throughout the month with no indication they will be lowered. Fresh-water fish prices, especially whitefish, while fluctuating considerably, kept on a fairly low and even level throughout the month.



## United States

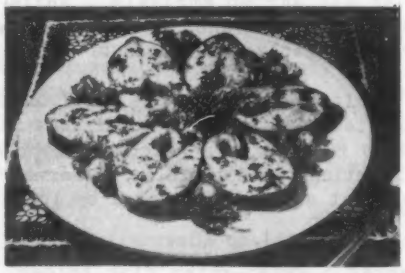
COLD-STORAGE FREEZINGS AND HOLDINGS: Stocks of frozen fish and shellfish held on August 1st by firms reporting their activities to the Fish and Wildlife Service amounted to 110,611,000 pounds, compared with 126,837,000 pounds on the same date in 1946, according to Current Fishery Statistics No. 361. Holdings increased 20,452,000 pounds during July, compared with an increase of 29,031,000 pounds in the same month the previous year. Increases in the holdings of four




items accounted for the major portion of the gain in stocks during July. These were halibut, up 7.2 million pounds; all classifications of whiting, up 5.6 million pounds; tuna, 4.5 million pounds; and salmon, 2.5 million pounds.

Data contained in this bulletin on the domestic freezing and holdings of frozen fishery products are based on reports from 213 plants. These are principally public cold-storage warehouses.

## BROILED SALMON STEAKS



2 lbs. salmon steaks
1 teaspoon salt
1/8 teaspoon pepper
4 tablespoons butter or other fat, melted

Sprinkle both sides with salt and pepper. Place fish on a preheated greased broiler pan about 2 inches from the heat. Brush fish with melted fat. Broil for 5 to 8 minutes or until slightly brown, baste with melted fat and turn carefully. Brush other side with melted fat and cook 5 to 8 minutes or until fish flakes easily when tested with a fork. Remove carefully to a hot platter, garnish, and serve immediately plain or with a sauce. Serves 6.

# CANNED AND CURED FISH

## Salmon

SALMON PACK: The Alaskan canned salmon pack, to and including July 26, amounted to 2,404,539 cases, according to Salmon Pack Report No. 5, issued by the Seattle Fishery Market News Office. This was almost a million cases, or 66 percent, more than the pack for the corresponding period last year. It also compares favorably with the 5-year average, exceeding it by a little over 1 percent. The packs of kings, reds, and pinks were substantially higher than those of last year. The canned red salmon pack showed the greatest gain, being almost twice the pack for the corresponding period last year.

Compared with the 5-year average, both kings and reds showed sizable increases, but the packs of the three other varieties were still running far behind.

Alaska Salmon Pack to and including July 26, 1947

| District | King | Red | Pink | Chum | Coho | Total |
|---|---|---|---|---|---|---|
| Western | 13,773 | 1,350,395 | 1 | 40,060 | 283 | 1,404,512 |
| Central | 35,018 | 418,376 | 381,850 | 89,344 | 32,138 | 956,726 |
| Southeastern | 3,456 | 15,539 | 9,619 | 10,804 | 3,883 | 43,301 |
| Total 1947, July 26 | 52,247 | 1,784,310 | 391,470 | 140,208 | 36,304 | 2,404,539 |
| All districts-- | | | | | | |
| 1946, July 27 | 29,967 | 942,221 | 225,092 | 208,199 | 46,479 | 1,451,958 |
| 1945, July 28 | 35,747 | 1,067,010 | 728,630 | 391,732 | 46,975 | 2,270,094 |
| 5-year average, July 28 | 39,121 | 1,418,268 | 525,053 | 344,219 | 45,781 | 2,372,443 |
| Total pack, 1946 | 31,874 | 1,040,747 | 2,041,636 | 581,763 | 184,088 | 3,880,108 |
| " " , 1945 | 42,514 | 1,177,523 | 2,239,643 | 689,001 | 201,790 | 4,350,471 |
| 5-year average | 42,219 | 1,339,307 | 2,305,352 | 819,212 | 219,465 | 4,725,555 |

## Tuna and Mackerel

TUNA AND MACKEREL PACK: During July, 838,618 standard cases of tuna were packed by California canners, according to the California Division of Fish and Game. This was a gain of 131,000 cases over the pack for July 1946, and increased

California Pack of Tuna and Mackerel--Standard Cases*

| Item | July 1947 | June 1947 | July 1946 | Seven mos. ending with July-- 1947 | 1946 |
|---|---|---|---|---|---|
| | Cases | Cases | Cases | Cases | Cases |
| Tuna: | | | | | |
| Albacore | 53,800 | 6,607 | 174,401 | 60,718 | 182,587 |
| Bluefin | 35,193 | 2,612 | 76,458 | 88,112 | 236,658 |
| Bonito | 151,938 | 16,544 | 210 | 181,283 | 5,249 |
| Striped | 107,127 | 79,575 | 74,197 | 369,443 | 242,801 |
| Yellowfin | 363,975 | 380,976 | 213,275 | 1,766,937 | 1,410,100 |
| Yellowtail | 16,655 | 7,942 | 2,893 | 35,082 | 27,430 |
| Flakes | 108,520 | 104,588 | 165,940 | 492,157 | 552,025 |
| Tonno style | 1,410 | 2,927 | - | 13,011 | - |
| Total | 838,618 | 601,771 | 707,374 | 3,006,743 | 2,656,850 |
| Mackerel | 9,175 | 1,398 | - | 226,108 | 54,909 |

*Standard cases of tuna represent cases of 48 7-ounce cans, while those of mackerel represent cases of 48 1-pound cans.

the pack for the first 7 months of 1947 to over 350,000 cases more than the pack for the same period last year. The pack of yellowfin, although less than that of June was far ahead of the July 1946 pack. The most notable increases, however, were made in the packs of albacore, bluefin, and bonito.

The pack of mackerel, for the second straight month, showed a substantial gain--9,175 cases being packed during July as compared with 1,398 cases in June. There were none reported as being packed during July 1946. As a result, the 7 months' total for 1947 is more than four times the 7 months' pack of 1946.

## LABELING OF FISHERY PRODUCTS

During the course of an appearance before the National Resources Economic Subcommittee of the Senate Committee on Public Lands, on July 2, 1947, Mr. L. D. Elliott, Assistant Commissioner of Food and Drugs, Food and Drug Administration, had the following to say about names for fishery products offered for sale:

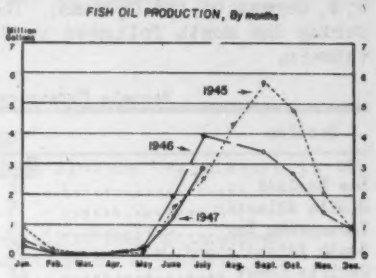
"A problem having to do with nomenclature sometimes looms up in connection with the development of a new fishery or with attempts to find new outlets for the product of an established fishery. There is nothing so confusing as the popular nomenclature used in connection with various fishes. The Food, Drug, and Cosmetic Act requires that a food be labeled with its common or usual name, if any there be. It is reasonable to require that the name under which a fish is offered for sale should be that which is customary, prevailing, universal, familiar, and popular in the sense that it is widely used and hence to be accepted as the common or usual name. Most fish available in commercial quantities have some sort of name long applied to identify them. Efforts to re-name them are sometimes directed towards the substitution of an attractive name for one which is felt to be unattractive. In other cases a proposal to coin a new name is in connection with efforts to reintroduce a fish to which the public has an aversion under a new, unfamiliar name which conceals its identity and misleads the consumer. In dealing with inquiries from the trade as to whether some new name of this kind is acceptable, this Administration is necessarily bound by the mandate laid down by the Supreme Court in a food and drug case some years ago, in which the Court held:

> "'*** It is not difficult to choose statements, designs, and devices which will not deceive. Those which are ambiguous and liable to mislead should be read favorably to the accomplishment of the purpose of the act. *** It was enacted to enable purchasers to buy food for what it really is. ***'"

# FISHERY BYPRODUCTS

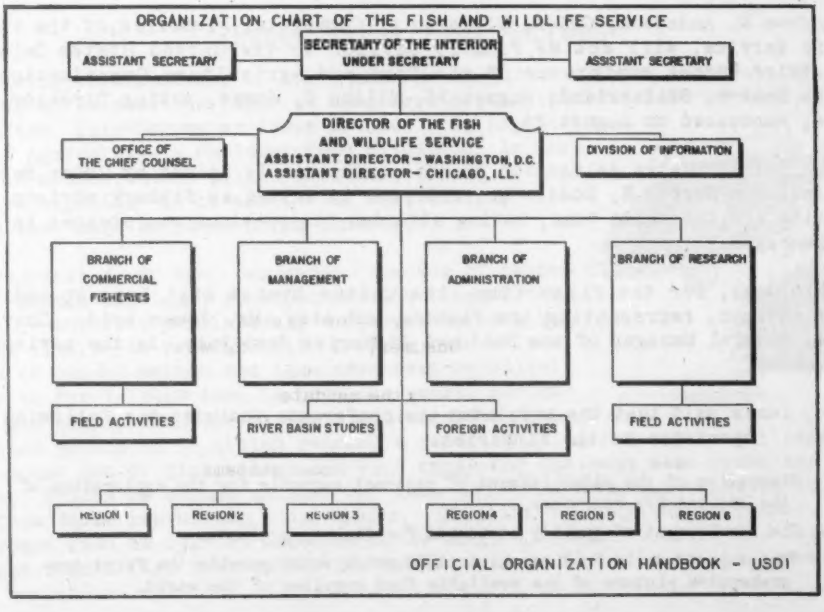
## Oil and Meal

PRODUCTION: Reduced production of herring and menhaden oils during July held the total yield of fish oils for the month to 2,857,923 gallons--28 percent below the July 1946 production, according to Current Fishery Statistics No. 366. The catch of menhaden during July, which is estimated at about 270,000,000 pounds, was 21 percent greater than the poundage taken in the same month the previous year. However, because of the low oil content of the fish, the production of oil was 32 percent below the yield in July 1946. The July production of fish meal by firms which normally produce 94 percent of the total domestic yield of this product amounted to 36,301 tons--12 percent above the July 1946 production.




The total production of fish oils during the first seven months of 1947 (4,800,395 gallons) was 29 percent below the 1946 yield for this period, while the production of meal (76,826 tons) was 2 percent below the production in the first seven months of 1946.





# OTHER FISHERY NOTES

## Additions to the Fleet of U.S. Fishing Vessels

A total of 140 vessels received their first documents as fishing craft during July 1947, compared with 132 in the same month the previous year, according to the U. S. Bureau of the Customs. The State of Washington led with 21 vessels documented during the month followed by California with 20 vessels, and Louisiana with 14 vessels.

Vessels Obtaining Their First Documents as Fishing Craft

| Section | July | | Seven mos. ending with July | | Twelve Months |
|---|---|---|---|---|---|
| | 1947 | 1946 | 1947 | 1946 | 1946 |
| | Number | Number | Number | Number | Number |
| New England | 11 | 9 | 52 | 40 | 86 |
| Middle Atlantic | 5 | 5 | 42 | 31 | 74 |
| Chesapeake Bay | 15 | 5 | 60 | 36 | 71 |
| South Atlantic and Gulf | 43 | 29 | 250 | 159 | 351 |
| Pacific Coast | 44 | 68 | 286 | 250 | 375 |
| Great Lakes | 10 | 10 | 46 | 47 | 76 |
| Alaska | 4 | 5 | 21 | 16 | 19 |
| Hawaii | 4 | 1 | 13 | 4 | 17 |
| Unknown | 4 | - | 11 | 10 | 16 |
| Total | 140 | 132 | 781 | 593 | 1,085 |

Note: Vessels documented by the Bureau of the Customs are craft of 5 net tons and over.

## U. S. Sends Fishery Advisors To FAO Conference

Andrew W. Anderson, Chief, Division of Commercial Fisheries, of the Fish and Wildlife Service, will act as fishery advisor to the United States Delegation to the third annual conference of the Food and Agriculture Organization which meets in Geneva, Switzerland, August 25, Milton C. James, Acting Director of the Service, announced on August 23.

The United States delegation to the conference is headed by Under Secretary of Agriculture Norris E. Dodd. Mr. Anderson is acting as fishery advisor to the delegation for the third time, having attended the previous conferences in Quebec and Copenhagen.

This year, for the first time, the United States will have an additional fishery advisor, representing the fishing industry, Mr. James said. Charles E. Jackson, General Manager of the National Fisheries Institute, is the advisor from the industry.

Mr. James said that the agenda for the conference includes the following items of special importance to the fisheries:

Discussion of the establishment of regional councils for the exploration of the sea and its resources.

The development of quality standards for fishery products.

The proposed world food census in 1950 which would provide the first comprehensive picture of the available food supplies of the world.

A progress report on a saltfish commodity study previously undertaken.

A report of the meeting of European fishery representatives held in Rome last June 23rd to consider means of widening the distribution of fish in Europe.

The Fisheries Division of the Food and Agriculture Association is headed by Dr. D. B. Finn, formerly Deputy Minister of Fisheries in Canada.

## Shrimp Sizes

Among the laws passed by the 1947 session of the Alabama Legislature is the following:

Act No. 59 (H. 102 by Stone, Sullivan and Johnston, all of Mobile), approved July 1, 1947. Amends Sec. 161, Title 8, to read "It shall be unlawful for any person, firm, corporation or association to sell, offer for sale, or have in possession for sale for commercial purposes any shrimp where it requires more than 40 with heads to weigh one pound or where it requires more than 68 headless shrimp to weigh one pound. This law shall apply to shrimp taken from the territorial waters of Alabama or brought into Alabama from waters beyond the territorial jurisdiction of Alabama. Nothing in this section shall be construed to apply to shrimp which are used solely as bait. Shrimp used as bait shall be controlled by regulation duly promulgated by the Director of Conservation."

## United States Fish Supplies

During the remainder of 1947, domestic supplies of fresh and frozen fish are expected to be about as large as they were during the last half of 1946, according to the July-September issue of the U. S. Department of Agriculture's National Food Situation. In the next few months, retail prices of most fresh and frozen fish are expected to be about the same as they were during the three years of price control.

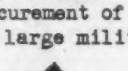
ROSEFISH

Production of the two major species of canned fish, salmon and tuna, is expected to be larger than in 1946, but only a relatively small part of the new pack is likely to reach retail markets before fall. Prices of canned salmon and tuna have been relatively higher so far in 1947 than in previous years. According to the Bureau of Labor Statistics, the retail price of canned salmon in 56 cities reached a record peak in June 1947--41.1 cents for a one-pound can of pink salmon and 63.3 cents for the same size container of red salmon. Prices of canned salmon and tuna this fall are not expected to differ much from those prevailing this summer. Civilian consumption of canned, fresh, and frozen fish in 1947 is expected to be slightly higher than it was last year, although canned fish consumption per person will still be below the prewar rate.

Imports of fresh and frozen fish in 1947 may be smaller than in the previous year. During the first six months of 1947, the imports of fresh and frozen groundfish fillets (cod, haddock, hake, pollock, cusk, and rosefish) were reported to be slightly less than half of the quantity imported during the same period a year ago. Canned fish imports are expected to show a marked increase over 1946, but may not equal the 1937 record.

Exports of canned fish are expected to be lower than the 187 million pounds exported in 1946, but above the 1935-39 prewar average of 93 million pounds.

Military requirements of canned fish out of the 1947 pack amount to about 14 million pounds compared with procurement of slightly less than a million pounds from the 1946 pack when there were large military stocks to be liquidated.



## Wholesale and Retail Prices

Reversing the downward movement of the previous two months, average primary market prices rose 0.6 percent from May to June, largely because of higher agricultural prices, according to the Bureau of Labor Statistics, U. S. Department of Labor. The index of commodity prices in primary markets increased to 147.8 percent of the 1926 average, 1.1 percent below the postwar peak reached in March. The index advanced 30.9 percent from June 1946, before suspension of OPA controls, and 97.1 percent since August 1939.

Wholesale and Retail Prices

| Item | Unit | | Percentage change from-- | |
|---|---|---|---|---|
| Wholesale: (1926 = 100) | | June 14,1947 | May 17,1947 | June 15,1946 |
| All commodities | Index No. | 147.6 | +0.4 | +32.0 |
| Foods | do | 162.4 | +0.8 | +45.3 |
| Fish: | | June 1947 | May 1947 | June 1946 |
| Canned salmon, Seattle: | | | | |
| Pink, No. 1, Tall | $ per doz. cans | 3.066 | 0 | +55.6 |
| Red, No. 1, Tall | do | 5.486 | 0 | +48.5 |
| Cod, cured, large shore, Gloucester, Mass. | $ per 100 pounds | 13.50 | 0 | 0 |
| Herring, pickled, N. Y. | ¢ per pound | 12.0 | 0 | 0 |
| Salmon, Alaska, smoked, N. Y. | do | 35.0 | 0 | 0 |
| Retail: (1935-39 = 100) | | June 15,1947 | May 15,1947 | June 15,1946 |
| All foods | Index No. | 190.5 | +1.5 | +30.8 |
| Fish: | | | | |
| Fresh and canned | do | 254.7 | -0.2 | +15.9 |
| Fresh and frozen | ¢ per pound | 37.0 | -1.1 | + 0.8 |
| Canned salmon: | | | | |
| Pink | ¢ per pound can | 41.1 | +1.7 | +16.8 |
| Red | do | 63.3 | +2.4 | +46.7 |

Retail food prices in large cities rose 1.5 percent between May 15 and June 15 to establish a new record high for the Retail Food Price Index for the third time in 8 months, reports the same source. The Retail Index advanced during the month to 190.5 percent of the 1935-39 average, 31 percent above mid-June 1946, the last month of extensive Government price controls, more than double the August 1939 index.

Fish, however, with the exception of canned salmon, did not follow the general trend. Compared with a month ago, conditions ranged from no change to a decline

of just over 1 percent. Compared with a year ago, the difference ranged from no change up to an increase of less than 1 percent. Canned salmon, on the other hand, continued to register substantial gains. These amounted to over 55 percent, in some cases, when compared with the same period last year.

## FISHERY STATISTICS OF THE UNITED STATES, 1943

Fishery statistics of the United States and Alaska are compiled and published annually[1] to make available information on both the economic and biological aspects of the domestic commercial fisheries.

Data on the economic aspects are necessary to persons engaged in the commercial fishery and to governmental agencies concerned with its regulation and protection. Those here given cover the total catch and value by species, the yield and value of manufactured products and by-products, the employment of men, craft, and gear in the capture of fishery products, employment in shore establishments, and related information.

From the biological standpoint, these data are important to sound fishery management in providing detailed information on fluctuations in the commercial catch by species, locality, and year, and on the types of gear and boats operated. They assist conservation agencies so to regulate the commercial fisheries as to produce maximum yields without depletion.

Previous statistical reports on the fishery industries issued under the Department of the Interior were as follows: Administrative Report No. 41, for 1938 (Appendix III to Report of Commissioner of Fisheries, 1940); Statistical Digest No. 4, for 1940; Statistical Digest No. 7, for 1941; and Statistical Digest No. 11, 1942. Reports for preceding years were issued in the Administrative Report series of the former Bureau of Fisheries.

1/Delayed during war years.

--Statistical Digest No. 14

# FOREIGN FISHERY TRADE

## Imports and Exports

GROUNDFISH IMPORTS: Imports of fresh and frozen groundfish (fillets, steaks, etc., of cod, haddock, hake, cusk, pollock, and rosefish), within quota limitations, under the reduced tariff provided under trade agreements, totaled 2,146,915 pounds during July, according to a preliminary report from the Bureau of Customs, Treasury Department. This was less than half the quantity imported during July 1946. The total for the first seven months of this year is likewise far behind the total for the corresponding period in 1946. Last year, the quota was exceeded before the end of June, but even at the end of July this year, the total of 13,961,852 pounds is nearly 10 million pounds short of the 1947 quota of 23,906,000 pounds, which can be imported at the reduced tariff of 1-7/8 cents per pound.

| Country | 1947 | | 1946 | |
|---|---|---|---|---|
| | July | 7-month Total | July | 7-month Total |
| Canada | 1,784,195 | 10,663,060 | 4,417,707 | 24,052,066 |
| Newfoundland | 362,720 | 2,354,320 | 713,710 | 2,838,940 |
| Iceland | - | 944,472 | 245,340 | 3,008,184 |
| Norway | - | - | - | 1,756 |
| Total | 2,146,915 | 13,961,852 | 5,376,757 | 29,900,946 |

## Africa

GOLD COAST FISHERY RESEARCH PROGRAM: Joint fishery research is under way in the British West African Colonies of Nigeria, Gold Coast, Sierra Leone, and the Gambia under Dr. Herbert H. Brown as Director of Fishery Research. Fishery departments in each of the Colonies will do extension work and collect statistics. There are also plans for a Fishery Research Institute and a research vessel.

There appear to be some interesting possibilities in the area. There is a fish uncommonly like porgie or menhaden called the "Bonga" (Ethmalosa dorsalis). It is caught in considerable quantities by cast nets in West Nigeria and Sierra Leone near the estuaries of big rivers. There is also a sardine, Sardinella aurita and Sardinella cameronensis, which is caught in the Gold Coast by quite highly developed gill nets (100 fathoms by 12 fathoms) worked both as drift nets and in the run-around fashion. Trawling is quite an unknown quantity, but the indications are rather more promising than in most tropical areas. Yellowfin tuna have been seen, too.

## British West Indies

BARBADOS FISHERIES: Fish landed throughout the Island during the month of June 1947 showed a marked increase over that of preceding months. Catches passed through the Bridgetown Fish Market amounted to about 52,778 pounds. This was 20,000 pounds in excess of the May figure. It may be noted that Fish Market statistics can give only a bare indication of the amount of fish landed in Barbados

as only about 16 boats use the Market and there are numerous independent fishermen.

During the same month, the Executive Committee passed regulations requiring all boat owners to register their craft annually, according to the American Consulate, Barbados, British West Indies.

More fish has been landed this year than in the past due to effective 1946 legislation whereby fishermen are granted loans from the Peasant's Bank under Agriculture Department supervision. Last year, £5,943 ($23,980)[1/] were issued in loans to fishermen, and recently another sum of $12,000 was provided for this purpose. The aforementioned Fish Market was built in 1946 by funds made available through the Colonial Development and Welfare Office.

## Canada

FISH LANDINGS BELOW LAST YEAR: Total landings of sea fish by Canadian fishermen during the first seven months of 1947 amounted to 538.7 million pounds compared with 599 million pounds in the same period of 1946, according to Monthly Review of Canadian Fisheries Statistics, July 1947.

Reduced prices to fishermen, particularly for cod, following a decline in export demands for frozen fish is reflected in the July statistics of fish landings. The catch of Atlantic cod in July 1947 amounted to 47.4 million pounds compared with 67.7 million pounds in the same month of 1946. The decline is most noticeable in Quebec and Nova Scotia. On the Pacific Coast, the salmon run has commenced in volume with landings of 28.3 million pounds in July of this year compared with 20.9 million pounds last year. The total catch of salmon to the end of July is substantially above that of last year. The West Coast halibut catch was also better this year.

FISHING SCHOONER

The value of the catch to fishermen during the first seven months of 1947 amounted to $24.7 millions, a drop of $5.6 millions from the returns of the same period of 1946. The decline was largely on the Atlantic Coast where returns from the cod and lobster catch have been sharply lowered as a result of the reduced catch and lower prices. Returns to fishermen in British Columbia are somewhat higher than last year.

In response to the strong demand for salted fish both from the traditional export markets and from the Government's relief purchase program, a substantially greater percentage of the catch of Atlantic cod, hake, and pollock is being processed in the salted forms. This represents a diversion from frozen products. Freezings of cod fillets in July of 1947 were sharply below those of the same month of 1946. As a result, stocks of cod fillets were comparatively low on August 1. There were no significant changes in the forms of sales of the main Pacific species, salmon and halibut.

1/Pound sterling equals $4.035.

Little change occurred in the price to fishermen or at retail during the past month. The composite index number of wholesale prices increased by 11.1 points over that of June largely as a result of higher quotations for halibut.

The total value of exports of fishery products up to the end of July at $38.3 millions was close to the 1946 figure, although there were considerable changes in the position of individual products. The value of exports of fresh and frozen cod fillets, whitefish, and lobsters show reductions, while the value of exports of fresh and frozen halibut and salmon were substantially greater.

Total stocks of fresh, frozen, and smoked fish on August 1 at 42.7 million pounds was only slightly above the total on August 1, 1946. Reduced holdings of fresh and frozen cod fillets were offset by higher stocks of smoked cod fillets, fresh haddock fillets, and frozen halibut. Stocks of fresh-frozen salmon and whitefish were also higher than on the same date in 1946.

## Japan

FISHING LICENSES: The following excerpts are taken from the "Weekly Summary No. 92 of the Natural Resources Section," of General Headquarters Supreme Commander for the Allied Powers:

EQUIPMENT AND SUPPLIES

1. Licensing of Trawlers

   a. Trawler licenses, issued by Japanese Bureau of Fisheries, are divided into three groups:

      (1) Large trawlers more than 200 gross tons;
      (2) Small trawlers from 40-180 gross tons; and
      (3) Small trawlers less than 50 tons.

   The first two groups operate only west of 130° E. longitude and north of 25° N. latitude.

   b. The Supreme Commander for the Allied Powers has authorized the issuance of 60 licenses of 10 years' duration, for the 200-ton and larger class, of which 59 have been issued; 930 licenses of 5 years' duration for the 40-180-ton class, all issued; 3,200 licenses of 5 years' duration for 50-ton and less class, all issued.

   c. Approximately one-fourth of the 40-180-ton class licenses have been issued to two large companies formerly operating in China and Formosa whose employees are now being repatriated to Japan. Two hundred of the present license holders did not operate trawlers before World War II. Licenses cannot be issued for 300 applications now on file, of which 20 percent operated trawlers before the war. There is a large backlog of applications on the 50-ton and less class which cannot be filled.

2. Licensing of Tuna and Bonito Boats

   a. A total of 50 companies and associations have been issued 121 permits, of which Showa Gyogyo Company holds 27 and Taiyo Gyogyo Company holds 17. Individual fisherman have been issued 365 licenses, making a total of 486 now in force. Experienced operators hold 278 and inexperienced hold 208. The present plan is to issue 155 additional licenses soon. The Japanese Bureau of Fisheries issues these licenses.

* * * * *

SEED OYSTERS: The Japanese seed oyster growers in southern Japan had prepared 30 cases of experimental seed for trial shipment to the United States in the spring of 1947, according to the State of Washington's Department of Fisheries. These seed oysters were examined on April 13, 1947, at Vatsushiro Bay in Kumamoto Prefecture in Japan and passed as being free from oyster pests.

CULTIVATING JAPANESE SEED OYSTERS

The Kumamoto oysters are said by the Japanese biologists to be a variety of Ostrea gigas which do not grow as large as the Japanese oysters formerly grown in this country and which have a very desirable flavor. The average adult shell measures 3 inches in length, 1-1/4 to 1-1/2 inches in width, and 5/8-3/4 inches in depth, and the meat is 1-1/2 inches long and 5/8 inch in diameter.

The potential seed production of this area is about 30,000 cases per year. The sample shipments were "hardened" by suspending shell strings at a very high tide level for several months stunting their growth and increasing their ability to withstand drying during shipment.

The 30 cases of seed were distributed as follows:

| | |
|---|---|
| Washington Department of Fisheries - 10 cases | California Fish & Game Commission - 5 cases |
| Oregon Fish Commission - 10 " | University of Hawaii - 5 " |

Plantings in Washington were in the following locations:

| | |
|---|---|
| Willapa Harbor - Nahcotta, Stony Point and Naselle areas | Belfair Bay - V. Sheppard's grounds |
| Grays Harbor - near Bay City | Dabob Bay - Rock Point Oyster Company's grounds |
| North Bay - State Reserve | Samish Bay - State Reserve, near Samish Is. |
| Oyster Bay - W. C. Patterson's ground | Vaughn Bay - G. M. Evans' raft |

Records are being kept of the growth rate and mortality of these oysters. If these oysters are found to grow as their parents do in Japan they should produce excellent cocktail oysters.

## Mexico

FISHING TARIFFS DEFINED: The accompanying order published August 8, 1947, is of interest to American shrimp and snapper vessels as it clarifies the application of the decree published July 2 wherein tariff rates for foreign boats operating in Mexican waters of the Pacific were applied to similar operations in Mexican territorial waters of the Gulf of Mexico and the Caribbean Sea. There are two articles to this order. Article I provides that only those species may be taken by foreign boats which do not have a permanent closed season, and which do not require a special permit for their capture. Those species requiring special permits are:

| | | | | | |
|---|---|---|---|---|---|
| whales | shrimp | oysters | turtles | seaweed | sponges |
| lobsters | pearl oysters | abalones | alligators | totoaba | sharks |

Shrimp, therefore, do not come within the provisions of the decree published July 2 and, hence, they cannot be taken in Mexican waters by foreign boats.

Article II provides that foreign boats fishing in Mexican territorial waters of the Gulf of Mexico and Caribbean Sea must abide by all the provisions of the law of December 26, 1938, covering fishing by foreign boats in Mexican territorial waters of the Pacific Ocean and the Gulf of California. The law of December 26, 1938, is given in translation in Appendix III of Despatch No. 3886 of June 12, 1947.

ORDER DEFINING THE APPLICATION OF THE TARIFF FOR COMMERCIAL AND SPORT FISHING IN TERRITORIAL WATERS OF THE GULF OF MEXICO AND CARIBBEAN SEA, BY VESSELS OF FOREIGN REGISTRY

WHEREAS, by the decree of June 20 of this year, published in the Diario Oficial of the Federation on July 2, fixing the tariff for commercial and sport fishing in territorial waters of the Gulf of Mexico and Caribbean Sea by vessels of foreign registry, returning to their bases with the products obtained, there were fixed fees which are identical, based on the same principles, and having the same purposes and ends as the tariff for commercial and sport fishing in waters of the Pacific Ocean and Gulf of California, dated November 17, 1939, and published in the Diario Oficial of the Federation on December 30 of that year;

WHEREAS, there is no reason to establish preferences nor inequalities with reference to the application of the two tariffs even though one, that covering the Pacific and Gulf of California, was based on the powers granted the Federal Executive by section I of article 89 of the General Constitution of the Republic in accordance with the provisions of articles 3 and 16 of the law of December 26, 1938; and the other, that covering the Gulf of Mexico and the Caribbean Sea, based on the powers granted the Federal Executive by the same section and article of the General Constitution of the Republic and in accordance with the provisions of article 10 of the Fishery Law of August 26, 1932;

WHEREAS, for purposes of the application of the tariff for commercial and sport fishing in territorial waters of the Gulf of Mexico and Caribbean Sea by vessels of foreign registry which return to their bases with the products obtained, it is necessary that the persons or companies engaged in fishery activities carry them out in accordance with the legal requirements and provisions of the Fishery Law of December 26, 1938; based upon articles 6 and 7 of the current Fishery Law, dated August 26, 1932, I hereby issue the following

ORDER:

I. The application of the tariff covered by the decree of June 20 of the current year, published in the Diario Oficial of the Federation on July 2, is effective only when it concerns the exploitation of the fishery products referred to in article 9 of the Law covering Fishing in Mexican Territorial Waters of the Pacific Ocean and the Gulf of California, of December 26, 1938.

II. The persons and companies carrying out fishery exploitations for the utilization of the species covered by article 9 of the Fishery Law of December 26, 1938, through the use of vessels of foreign registry which return to their bases with the products obtained, referred to by the tariff fixed by the decree of June 20, 1947, published in the Diario Oficial of July 2 of this year, shall adjust all their operations to

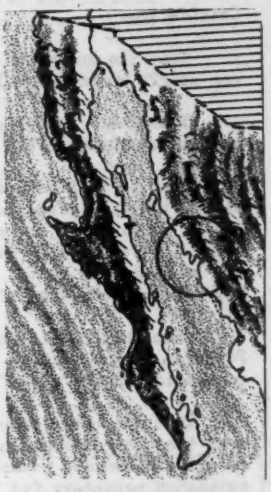
the regulations and provisions applicable, as contained in the Law covering Fishing in Mexican Territorial Waters of the Pacific Ocean and the Gulf of California, of December 26, 1938.

The above order was signed July 21, 1947.

* * * * *

GUAYMAS SHRIMP INDUSTRY: The receipt by the cooperative societies of shrimp fishermen of a circular order dated July 15, 1947, from the Director of Fishing and Related Industries at Mexico City prohibiting them from operating with other than their own vessels and equipment caused considerable apprehension at this port, according to the American Consulate, Guaymas, Sonora, Mexico.

Guaymas' economy is based on the shrimp industry and while the existing laws (Presidential Decree of July 31, 1934, amended by Presidential Decree of July 11, 1940) restrict the fishing for shrimps in Mexican waters to the cooperative societies. The local cooperative societies have only 18 of the 214 shrimp vessels which operate out of this port. Heretofore, this restriction has been surmounted by a technicality. The independent ship owners have been operating under certain agreements with the cooperative societies whereby the latter sell their catches on a commission basis.



GULF OF CALIFORNIA

In view of the seriousness of the matter, the Governor of the State, who is himself a large stockholder in many of the independent fishing enterprises of this district, and a representative group of independent ship owners immediately proceeded to Acapulco where President Aleman was spending a vacation in order to present their case to him in an endeavor to have the order in question rescinded or adequate legislation passed to permit them to continue to engage in this industry. It is known already that their mission was successful and that the President requested that, pending the revision of the laws on the subject, orders be issued permitting the independent fishermen to continue to operate as heretofore; that is, under the licenses of the cooperative societies. So far, this new order has not been received in Guaymas.

As customary, the shrimp packing plants closed down in June for the duration of the summer closed season and they are scheduled to remain closed until the latter part of September. Fishing for shrimp in protected waters will begin during the first part of August. Although authorized, deep-sea fishing is not practiced by the local fishermen because of their lack of equipment.

# Peru

ASSERTS SOVEREIGNTY OVER CONTINENTAL SHELF: Executive Decree dated August 1, 1947, asserts Peruvian sovereignty and jurisdiction over the submarine platform or continental shelf contiguous to the Peruvian coast and over waters extending 200 marine miles off the coast. It also declares with respect to Peruvian islands that the zone of jurisdiction shall extend 200 miles from points of their contour, according to a report received from the American Embassy at Lima, Peru.

A translation of the Decree follows:

NATIONAL SOVEREIGNTY AND JURISDICTION EXTENDED OVER THE CONTINENTAL AND INSULAR SHELF

The President of the Republic

Considering:

That the submarine platform or continental shelf forms together with the continent one single morphological or geological unit;

That there are in said continental shelf natural resources whose ownership by the nation must necessarily be proclaimed;

That it is likewise necessary for the State to protect, preserve and regulate the use of the fish resources and other natural resources which are found in epi-continental waters which cover the submarine shelf and in the continental seas adjacent thereto, in order that such resources, essential for national needs, may continue to be exploited or may be exploited in the future in such a manner as not to be harmful to national economy, nor to its production of foodstuffs;

That the fertilizing materials deposited by guano birds on the islands along the Peruvian coast likewise require for their conservation, the protection, preservation and regulation of the use of fish resources which serve as a food supply for such birds;

That the right to proclaim the sovereignty of the State and national jurisdiction over the entire extension of the platform or submarine shelf, as well as over the epi-continental waters covering same and over the waters of adjacent seas, throughout the extension necessary for the conservation and care of the resources contained therein, has been declared by other States and admitted in international practice (Declaration of the President of the United States of America of September 28, 1945; Declaration of the President of Mexico of October 29, 1945; Decree of the President of Argentina of October 11, 1946; Declaration of the President of Chile of June 23, 1947);

That Article 37 of the Constitution provides that mines, lands, forests, water and in general, all natural sources of wealth shall belong to the State, except rights acquired legally;

That in the exercise of sovereignty, and for the protection of National economic interests, it is the obligation of the State to fix clearly the maritime dominion of the nation, within which the protection, preservation and vigilance of the natural resources mentioned above should be exercised.

In accordance with the consultative vote of the Council of Ministers:

It is hereby decreed:

1. To declare national sovereignty and jurisdiction over the submarine platform or continental or insular shelf adjacent to the continental or insular coasts of the national territory, whatever the depth and extension of such shelf.

2. National sovereignty and jurisdiction shall likewise be exercised over the sea adjacent to the coasts of the national territory, whatever the depth and extension necessary to reserve, protect, preserve and utilize the resources and natural wealth of all kinds that may be found in or under said ocean.

3. As a consequence of the foregoing declarations, the State reserves the right to establish the boundaries of the zones of control and protection of the national resources in the continental and insular seas which remain under the control of the Government of Peru, and to modify such boundaries in accordance with the circumstances arising from new national discoveries, studies, or interests which may be made known in the future; and consequently, it is hereby declared that (the State) shall exercise such control and protection over the ocean adjacent to the coasts of Peruvian territory in a zone included between those coasts and an imaginary line parallel to them (coasts) and drawn on the ocean at a distance of 200 miles, the line following the geographic parallels. Concerning national islands this boundary shall be drawn to indicate a zone in the ocean adjacent to the coast of such islands, to a distance of 200 marine miles, measured from each one of the points of their contour.

4. The present declaration does not affect the right of free navigation of vessels of all nations, in accordance with international law.

Issued in the Government Palace, Lima, the first day of August of 1947.

José Luis Bustamante Rivero

Enrique García Sayán

## JAPAN'S AQUICULTURE

The practice of aquiculture (culture of fish, shellfish, and seaweed) is highly developed and illustrative of the importance attached to fisheries by Japanese. Species raised include carp, eel, oyster, clam, and seaweed as well as trout and other fresh-water fish. The output from this production contributes considerably to the food supply.

--Fishery Leaflet 249

# RECENT FISHERY PUBLICATIONS

Listed below are informational publications which recently have been processed by the Division of Commercial Fisheries. The publications are available, free of charge, from the Fish and Wildlife Service, U. S. Department of the Interior, Washington 25, D. C.

| Number | Title |
|---|---|
| CFS-352 | Frozen Fish Report, July 1947 |
| CFS-353 | Maine Landings, May 1947 |
| CFS-358 | Massachusetts Landings, April 1947 |
| CFS-362 | Maine Landings, June 1947 |
| FL-250 | The Cuban Shark Industry and Cuban Government Fosters Fishing Cooperatives |
| FL-251 | Gold Coast Sea Fisheries |
| FL-254 | List of Fishery Associations in the United States and Alaska |
| FL-256 | Outlook for Newfoundland Fisheries, 1947 |
| FL-257 | State Trading in Iceland with Respect to its Fisheries |

Reprints (Separates) from Commercial Fisheries Review, August 1947.

Sep. No. 181 - Some Studies on the Feeding Value of Fish Meals
Sep. No. 182 - Some Studies on the Content of Thiamine and Anti-Thiamine Factor in Fishery Products
Sep. No. 183 - Ultraviolet Absorption Curves for Vitamin A Using Tungsten and Hydrogen Discharge Light Sources

Designations for fishery publications are interpreted as follows:

CFS - Current fishery statistics of the United States and Alaska.

SL - Statistical lists, consisting of lists of dealers of fishery products and manufacturers of byproducts.

FL - Fishery leaflets.

MDL - Market development lists of frozen food locker plants and locker associations.

Illustrator -- Shirley A. Briggs Compositors -- Jean Zalevsky and Norma C. Dressler

Processing -- Miscellaneous Service Division

30317

## STUDIES ON OYSTER FEEDING

**These studies were conducted to learn what effect different concentrations of micro-organisms in sea water may have on the feeding activities of oysters. The micro-organisms were those which are considered as oyster food. Of these, *Chlorella* sp., *Nitzschia closterium* and *Euglena viridis* were most often used. It was found that heavy concentrations of micro-organisms interfered with the feeding of oysters by reducing the rate at which the oysters filtered the water through their gills. The type of shell movement was usually changed when the oysters were kept in water rich in micro-organisms. In very heavy concentrations pumping, and therefore feeding, ceased entirely. A correlation between the density of micro-organisms and the rate of feeding was often noticed. In light concentrations the rate of feeding and shell movements of the oysters remained normal and sometimes the presence of small quantities of plankton in sea water stimulated the pumping activities.**

**The size of the micro-organisms was found important because a much larger number of small cells, such as *Chlorella*, was needed to produce the same effect as caused by a smaller number of larger cells. Both the cells of the micro-organisms and the products which they released in the water affected the oysters. The cells interfered with the normal function of the gills, while the products which they released contained substances inhibiting the oysters.**

**The quantities of pseudo feces were usually roughly proportional to the quantities of food cells present in the water, whereas a reverse relationship existed in the formation of true feces. The presence of large quantities of pseudo feces usually indicated that feeding proceeded under the unfavorable condition caused by a heavy concentration of food cells in the water.**

**The results of the experiments showed that oysters feed efficiently only if the water contains small quantities of suspended matter. Oysters can also feed in water containing a relatively large number of micro-organisms, but under such conditions the rate of feeding is decreased.**

EFFECT OF DIFFERENT CONCENTRATIONS OF MICRO-ORGANISMS
ON THE FEEDING OF OYSTERS (O. VIRGINICA) -- FISHERY BULLETIN 42

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U. S. Department of the Interior,
Washington 25, D. C.

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THE WORLD'S PILCHARDS
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Pilchards, like other herring-like fishes, are called sardines when canned. Some authorities refer to them as the "true" sardines. They are found in temperate coastal waters where surface sea temperatures average 50° to 70° F.
SARDINOPS
sagax
caerulea
melanostica